JACK BINNS' RADIO DEPARTMENT

Popular Science

FOUNDED MONTHLY 1872

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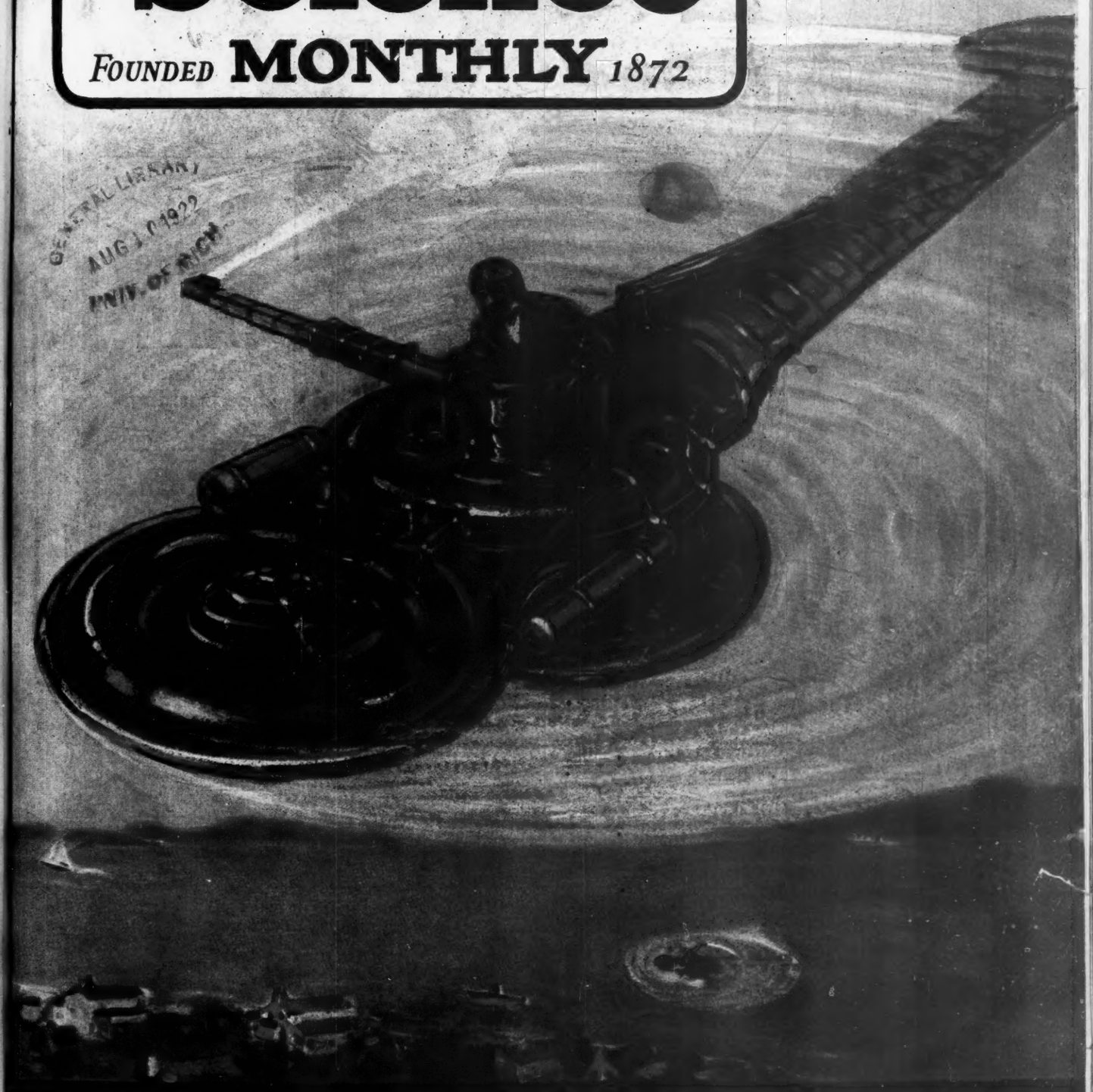

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Will "Whirling Leaf" Aircraft Revolutionize Flying? (See page 24)

Inventor of Crystal Detector Tells His Radio Secrets

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—When Others Do It So Easily

He Does It

"Last week my earnings amounted to $554.37; this week will go over $400."—F. Wynn, Portland, Ore.

So Does He

"I have never earned more than $60 a month. Last week I cleared $306 and this week $218.—George W. Kearns, Oklahoma City, Okla.

—And He

"The very first month I earned $1,000. I was formerly a farmhand."—Charles Berry, Winterset, Ia.

—And He

"After spending ten years in the railway mail service at salaries ranging from $900 to $1,600 year I decided it was necessary for me to make a change. . . . My earnings during the past thirty days were more than $1,000."—W. Hartle, Chicago, Ills.

WHEN a farmhand steps from $50 to $1,000 a month—when a fireman jumps from $60 a month to a job paying him $500 for two weeks' work—when a former railway mail clerk, at a yearly salary of $1,600, changes his job and earns $1,000 in thirty days—and when hundreds of others quickly jump from small pay to magnificent earnings in the same way—then it's a shame for you not to do equally as well.

There is nothing exceptional about these men. They'd tell you that themselves. Many had been clerks, bookkeepers, mechanics. Some had been policemen, farmhands, firemen. And then in one swift stroke they found themselves making more money than they had ever dreamed possible. The grind of routine work—the constant struggle to obtain even a small increase—all this was left behind. To-day they know the thrill of making big money; they are no longer ruled by an office clock. There is genuine enjoyment in every hour of the day, for their work is filled with real fascination. They have found not only the most interesting, but the best paying, branch of all business.

A field that they had never dreamed of as theirs they found to be easy and uncrowded. Earnings that they had always *hoped* to reach and that their old jobs could *never* have paid, were right there in this new field waiting for them. Hundreds of others have found success the same way. You can too—let us tell you how.

How You Can Do It Too

What these men have done, hundreds of others have done, hundreds are doing to-day, hundreds will do to-morrow. And *you* can be one of them! For now the same opportunity that put these men into the big-money class is open to you!

In the first place, they discovered a vital fact about business. They discovered that the big money is in the Selling end of business. In the second place, they discovered a new and amazingly easy way that will make *any* man of average intelligence a Salesman, no matter what job he held before.

Salesmen are the very life-blood of any concern—upon them depends the amount of profits made. The men who can put a product on the market and boost its sales are absolutely indispensable. No wonder that man for man Salesmen receive the highest pay. For the men who are Masters of Salesmanship—there is practically no limit to their earnings—except the limit they set themselves. And that is how these men and hundreds of others like them found the way to their present handsome incomes. They are all Master Salesmen now!

Yet previously they had no idea of becoming Salesmen. If you had told them success awaited them in the field of Selling, they would have laughed at you. They would have told you that it was absurd to think of it—for they had never sold a dime's worth of goods in their lives. Then they learned of a great organization of top-notch Salesmen and Sales Managers formed for the great opportunities in the field of Salesmanship and to help them to positions in the lines that most appeal to them. Step by step—in their spare time at home—this great organization, the National Salesmen's Training Association, took them through every phase of selling. Every underlying principle of salesmanship was made as simple as A-B-C. Then as soon as they were qualified and ready, the Free Employment Service of this Association helped them secure good Selling positions. Almost before they realized it they were in the big-money class.

SEND FOR REMARKABLE FREE BOOK AT ONCE

The same opportunity that has brought hundreds of others their good fortune is open to you. Whether or not you have ever thought of becoming a Salesman, you should examine the facts about the tremendous possibilities for big earnings in this fascinating field. Mail the coupon. This will place you under no obligation. It simply means that you will receive, *entirely free*, a remarkable illustrated book, "Modern Salesmanship," and the personal stories of men in every part of the country who to-day are enjoying splendid success and earning five, ten and fifteen times as much money as ever before. It's a shame for *you* not to make big money when others do it so easily! Make a start now. Mail the coupon at once to the National Salesmen's Training Association, Dept. 15-M, Chicago, Ills.

National Salesmen's Training Association,
Dept. 15-M, Chicago, Ills.

I simply want to see the facts. Send me FREE your book, "Modern Salesmanship," and proof that I can become a Master Salesman. Also list showing lines of business with openings for Salesmen.

Name.....

Address.....

City..... State.....

Age..... Occupation.....

POPULAR SCIENCE MONTHLY

SEPTEMBER, 1922; Vol. 101, No. 3
25 cents a Copy; $3.00 a Year

Published in New York City at
225 West Thirty-ninth Street

Even the Blind Praise It

A GROUP of 60 blind men in Cincinnati are periodically entertained by a leader who reads to them aloud from current publications. After a recent reading of POPULAR SCIENCE MONTHLY, the verdict of the sightless listeners was, "Give us more of that magazine!" Questioned on their enthusiasm, the men declared that from the articles in POPULAR SCIENCE MONTHLY they could better visualize what was going on in the world than from any other book.

It is dramatic that POPULAR SCIENCE MONTHLY, founded 50 years ago by a blind scientist—E. L. Youmans—should today be preeminently a boon to men suffering from his affliction.

The Text, Too!

OUR extraordinary pictorial quality—the fact that we publish a greater variety of informative pictures of mechanical and scientific progress than any other general magazine in the world—is often taken as our most distinctive feature. But fundamentally the magazine's character lies in the fascination of the subjects covered. Hearty enjoyment of POPULAR SCIENCE MONTHLY by the blind who cannot appreciate its photographs is unique testimony as to the striking appeal of the printed articles themselves. How carefully do you read them?

Next Month

THE Einstein theory has kept two continents talking for many months, even though its sponsor says there are only a few men on earth who really understand it. Whether or not you are one who can grasp the theory, you can easily understand the remarkably dramatic experiments that are being made by American and British scientists, this fall, to test its accuracy. They will be described in a fascinating article in our next issue, which will contain other scientific news features.

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By Jack Binns

And 197 Important News Articles

THE HOME WORKSHOP
Half a Hundred New Ideas for Tool Users, pages 73-112

$75 in Prizes—See pages 28 and 82

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H. J. Fisher, President; R. C. Wilson, Vice-President; O. B. Capen, Secretary and Treasurer.

What Some Readers Say

BERT FAULKNER, General Manager of the Woods Brothers Construction Company, writes us:

We wish to compliment you on the story in your July issue concerning our Missouri River bank protection work.

Both in illustrations and text, the story is the most complete that has been edited. Various phases of our work have appeared in practically every technical and scientific magazine in the United States; but to our knowledge there has never been one so well written, or with illustrations presenting the story so well as the article in your magazine."

Harry White, of the White Sales Company, Washington, D. C., writes,

As I buy each copy of POPULAR SCIENCE MONTHLY I find that it more than pays for itself with the information in the Home Workshop section alone. Ever since I bought the first copy I have been keeping a scrapbook, which has now reached nearly 600 pages. I would not part with this book for a dollar a page.

Help Wanted!

MANY letters, of which the above two are typical, encourage us to believe that POPULAR SCIENCE MONTHLY is fulfilling more satisfactorily each month its task of bringing you the most complete news of the great world of science and mechanics. But constructive criticism helps more than praise. We want every reader's coöperation in editing this magazine. Send along your suggestions for improvement.

Time Savers

MEANWHILE, Mr. White's letter again brings up the question of whether *you*, also, are saving for future reference articles from the Home Workshop. They contain invaluable time-, labor-, and money-saving ideas for home, shop, and garage—ideas that should be kept on file for use when you need them most.

Power Tubes

THE most revolutionary effect of vacuum tube development will be outside of radio altogether. The invention of marvelous new super-tubes for transforming high voltage currents will be described by Jack Binns in our next issue.

POPULAR SCIENCE MONTHLY
September, 1922

Welcome to the Hottest Spot on Earth!

From Tourist Hotels in Death Valley Will Be Visible Both the Lowest and Highest Places in the United States

By John Edwin Hogg

THE ghastliest yet most entrancing desert on the face of the earth is to be made a vacation playground! Death Valley, that vaguely famous mystery spot in eastern California, 337 feet below sea level at its lowest point, sweltering under summer temperatures up to 160 degrees—is to be robbed of its sting and thrown open to tourists, who in winters to come may delve into its fascinating mysteries in ease and comfort.

Tourist Hotels Planned

This transformation is to take place when a Western railroad realizes its ambition of building an extension—for which ground has already been broken—into the valley, and of erecting a chain of first-class tourist hotels, disclosing to travelers a magnificent panorama whose scenic marvels have hitherto been locked from visitors by the hot hand of death.

So extraordinary and varied are the natural wonders associated with Death Valley that its ultimate opening to the tourist is expected to make it as nationally famous as is now the Grand Canyon of Arizona.

Right in the mouth of this inferno, where nature herself has poisoned the few springs, and where, in summer, a man without water may die of fever within an hour, is located Furnace Creek Ranch, one of the queerest farms in the world.

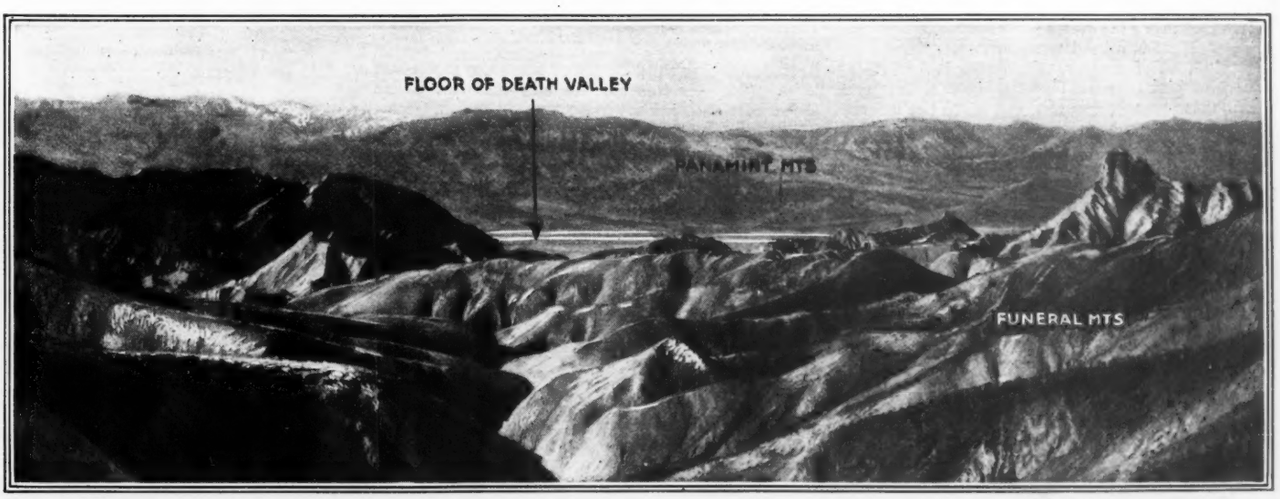
Here, 187 feet below sea level, alfalfa and vegetables are raised, thanks to irrigation and the efforts of Indian farm hands.

Once the bed of a vast inland sea, the parched floor of Death Valley displays interesting salt formations such as this. The weird pinnacles are almost pure salt, some of them three feet high, and all as hard as concrete

Two white foremen met death by daring to spend a second summer at this ranch, and two others, equally courageous, went insane. Only one white man, Oscar Denton, of San Diego, has ever spent more than two summers at Furnace Creek Ranch, and he recently quit—after eight years—to be succeeded by Victoriano Cebellos, a Mexican.

At Ryan, in the mountains above this ranch, one of the projected hotels will be built, and from its verandas the tourist will be able to see in a single glance both the lowest and the highest spots in the United States! The first is the dazzling, salt-crusted floor of Death Valley itself, averaging 276 feet below sea level; the second the magnificent, snow-clad peak of Mount Whitney, looming up a hundred miles away, above the Panamint Mountains.

Knowledge of the geology of this topsy-turvy region adds dramatically to the

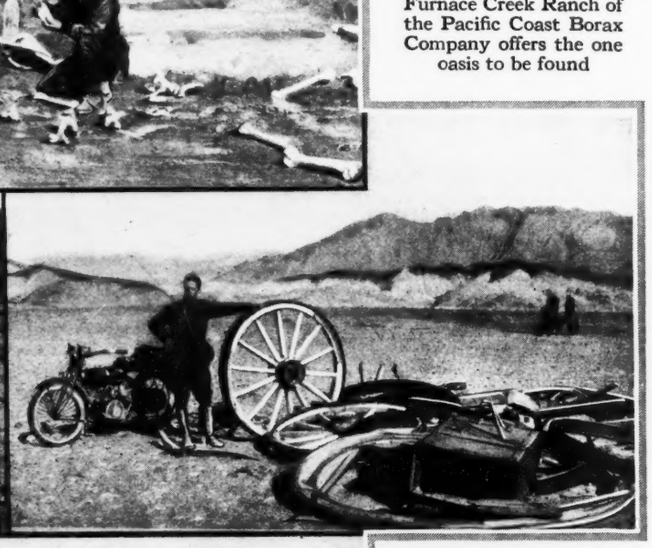


Part of the Frying Pan salt marsh on the floor of Death Valley, 276 feet below sea level, is seen almost in the center of this panoramic view taken from the Funeral Mountains to the east of the valley and at an elevation of about 4000 feet. In the background, about 30 miles distant, is the Panamint Range, which shuts off rain-bearing winds from the valley

Death Valley Photos Taken for Popular Science Monthly

ADORNED with bones of horses, the grave of a Furnace Creek ranch foreman, shown at the right, is one of many tragic spots in Death Valley. Driven insane by the heat, this foreman attempted a fatal flight from the merciless valley

THE traveler who runs out of water in Death Valley may count the span of life in minutes; for the springs are usually saturated solutions of poison. The Furnace Creek Ranch of the Pacific Coast Borax Company offers the one oasis to be found



TYPICAL VALLEY VISTA

Above is the extreme southern end of Death Valley, as viewed from Cave Canyon. This canyon drops down into the valley through the Avawaap Mountains on the south, descending from an elevation of 5800 feet to 50 feet below sea level within a distance of nine miles. The automobilist has to make his own road down the wash

A RELIC OF '49

A ghastly reminder of the fate of early gold seekers who lost their way and perished during the rush of 1849, is this pile of wagon wreckage at Lost Wagons on the floor of Death Valley. Note how the wooden wheels have been perfectly preserved, due to the extraordinary dryness of the atmosphere

FAMOUS BORAX CLIFFS

Below are shown mountain stores of vast wealth —the borax cliffs of Funeral Range, bounding Death Valley on the east. Here is mined the world's chief supply of commercial borax. The cliffs rise to an elevation of about 4000 feet

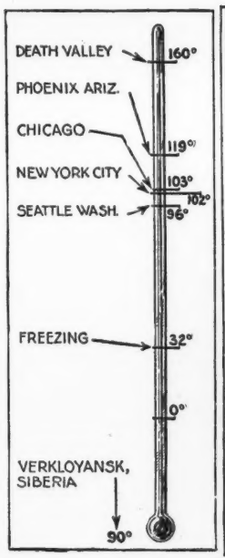
ALONG the barren, shifting sand dunes of the snow white valley many a luckless traveler has lost his way and has perished in the inferno. The dunes shown above rise about 150 feet from the valley floor, forming vast mounds of powdered sand

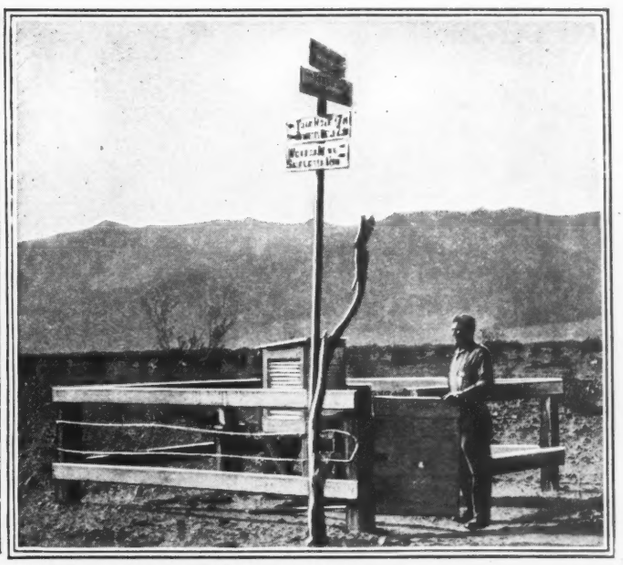
A DESERT SIGN POST

Until recently the only sign posts in the desert hole were those erected by prospectors and other dauntless desert travelers. Signs like those shown below have been replaced by metal guide posts erected by the government

visitor's interest in it. In some dark, prehistoric age, when the western half of our continent was pushed up out of the sea, three great ranges of mountains were formed, creating the valley of mystery and tragedy that later earned its name by a propensity for swallowing up luckless prospectors in the days of the gold rush and later. These three ranges of mountains are the Funeral Range, forming the eastern margin of Death Valley close to the Nevada state line; the Panamint Range, bounding the valley on the west, and the High Sierras, the loftiest mountains to be found within the continental limits of the nation, and extending north and south almost the entire length of California.

When the western half of the continent was new, Death Valley was not the heat-tortured waste that it is today, for it was then a great salt lake, 100 miles long, and from 6 to 15 miles wide, lying between the Panamint and Funeral ranges. The water in this inland sea was simply retained in the great depression between the mountains when the continent was pushed up from the floor of the ocean.

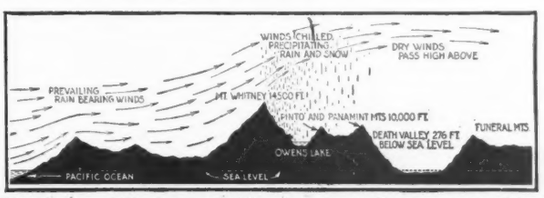




Where It Really Gets Hot

TEMPERATURES up to 160° in the sun and 134° in the shade—the highest ever recorded on the face of the earth—have been registered at the United States weather station in Death Valley, shown above.

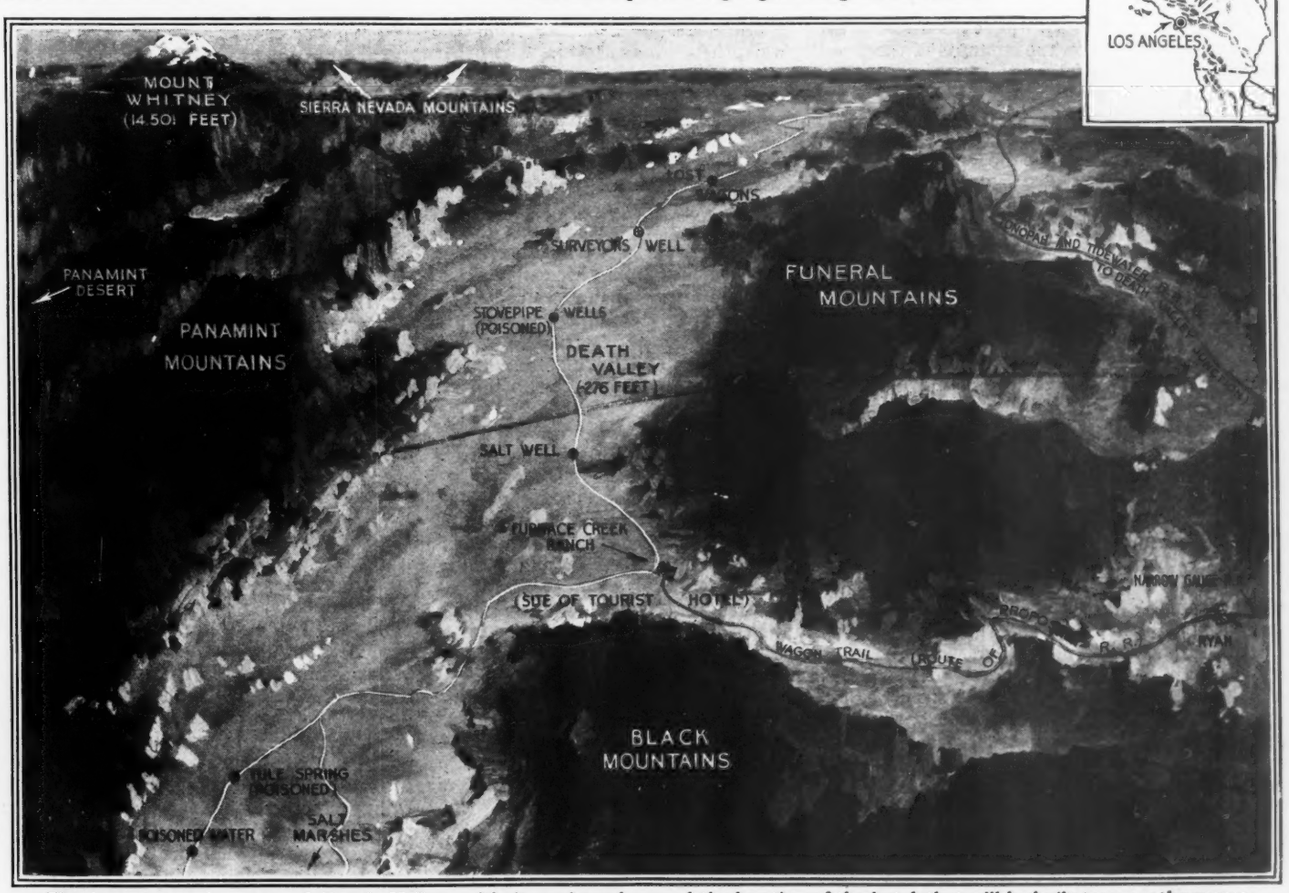
Extreme temperatures, officially recorded in the hottest and coldest spots on earth, and at cities in various sections of the United States, are indicated at the left. Temperatures, except the first, are taken in the shade


WINDS CHILLED, PRECIPITATING RAIN AND SNOW
DRY WINDS PASS HIGH ABOVE
PREVAILING RAIN BEARING WINDS
MT. WHITNEY 14,501 FT.
PINTO AND PANAMINT MTS 10,000 FT.
DEATH VALLEY 276 FT. BELOW SEA LEVEL
FUNERAL MTS
OWENS LAKE
PACIFIC OCEAN
SEA LEVEL

The above profile shows vividly the extraordinary geographical features surrounding Death Valley and causing its arid heat, while the map at the right gives its general location

The prevailing rain-bearing winds that blow eastward across the Pacific Ocean, and across California, run afoul of the High Sierras near the central portion of the state.

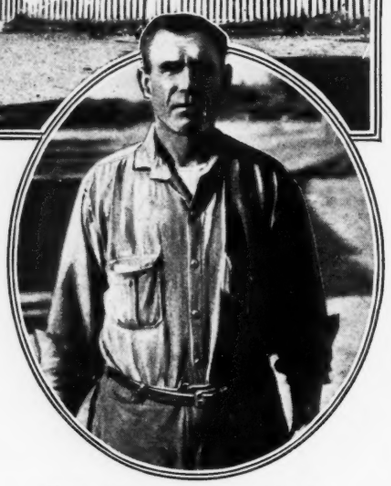
All along the west side of Death Valley, for a distance of 50 miles, these mountains present an almost unbroken wall of giant snowy peaks, among them the giant of all, Mount Whitney, towering 14,501 feet above sea level. In passing these mountain barriers, the rain-bearing winds are driven to a very high elevation, where they are suddenly chilled, and their moisture is precipitated in the form of snow or rain, on the westerly slopes of the ranges. Having



The heat-tortured wastes of Death Valley, with its poisoned wells and salt marshes, hemmed in by mountain ranges, are shown in this bird's-eye view, including the route of the railway and the location of the hotel that will be built to open the scenic wonders of the valley to tourists. Spots of strange romance and tragedy, pictured on page 20, are indicated

Death Valley's One Oasis

Furnace Creek Ranch, one of the world's most extraordinary irrigated farms, 187 feet below sea level, is the one oasis in Death Valley, the creation of the Pacific Coast Borax Company. Sufficient water to irrigate 65 acres is brought in from two large springs in the Funeral Mountains



Oscar Denton, foreman of the Furnace Creek Ranch for eight years, is the only white man who ever survived a second summer in the blazing heat of the valley

virtually gone through a dry cleaning process, the winds proceed to the east of the Sierras. This accounts for the great Panamint Desert, where very little rain ever falls, and which composes the area west of the Panamint Range and east of the High Sierras.

In crossing the Panamint Desert, much of the moisture still left in the eastbound rain-bearing winds is evaporated. Then these winds bump against the Panamint Range itself—the great, gnarled peaks towering to more than 11,000 feet. Again the winds are driven upward, chilled and forced to precipitate on the summits of the range what little moisture they may still contain. By the time these winds pass beyond the Panamints, they are almost totally dehydrated, making of Death Valley a waterless desert—the one region on earth where rain is virtually unknown.

Yearly Rainfall Almost Zero

Scientific records of Death Valley rainfall, during the past several years, reveal that the average annual precipitation is a little less than three tenths of an inch, as compared with an average of over 22 inches in San Francisco. This precipitation may come in a single sudden shower, or may be spread out through the entire year. Its sum total is scarcely more than what most of us would consider a light fog.

Analysis of the atmosphere at Furnace Creek Ranch, on the floor of Death Valley, has revealed that the average moisture content of the air is less than one one-hundredth of one per cent. With practically no rain at all, and with the dry atmosphere, like a blotter, constantly soaking up all moisture, we can easily imagine what became of the inland sea that formerly existed over the floor of the valley. The sea simply disappeared into space, leaving a hole with a maximum depth of 280 feet below ocean level, and a valley floor incrusted with salt, soda, borax, and other mineral substances, to which no bottom has yet been found. The depression is really the "subcellar" of the United States—the deepest hole on earth, with the exception of the Dead Sea region of Palestine.

Besides the extreme dryness, latitude, and lack of vegetation there are two other factors contributing to Death Valley's fatal summer climate. One of these is the heavy atmospheric pressure resulting from the valley's depth below sea level. The other is the similarity to a bake oven between the heat-radiating lower slopes of the mountains. The Funeral Mountains on the east rise up almost perpendicularly from below sea level to more than 6000 feet. They are waterless, burned-out volcanoes without a sprig of vegetation. The Panamints rise on the west to heights above 11,000 feet, and are waterless and barren up to about 6000 feet from the valley floor.

Most mountains have a well defined "tree line," above which foliage disappears. In this region of nature's freakiness, the tree line is also found, but it is one *below* which, instead of above which, no foliage exists.

Mountainsides Are Burned Wastes

The tops of the Panamints are perpetually snowclad, and the resulting moisture gives them a luxuriant growth of piñon pine. Water from the melting snow runs down on the Death Valley side of the range, and supports a luxuriant growth of vegetation until all of it is absorbed by the trees and brush, or is evaporated. Below the 6000-foot level water rapidly vanishes, and with it the trees, so that the side of the range next to the valley is a burned waste.

Through the dry, transparent atmosphere of the desert the sun's rays pass with little or no obstruction, to beat with unrelenting fury upon the barren slopes of the embracing mountains and the salt and sand of the valley. The heat is in turn radiated into the atmosphere as from a furnace lining, so that the valley is a veritable bake oven from the first of May until the middle of October.

Some of Death Valley's victims have undoubtedly perished from thirst, for water holes of drinkable liquid are scarce. Many of the springs are saturated solutions of mineral arsenic, cyanid, and other poisons, which cause death or serious illness to the man who drinks from them. But the terrific heat, raising human blood temperature in a short time to an unendurable fever, has caused more deaths than thirst. The body of many a prospector has been found beside his full canteen.

When we consider Death Valley from the standpoint of its summer climate, its appalling waste, its strange legends of death and suffering, its complete isolation from the rest of the world, we naturally ask: "How on earth is it to be commercialized to tourist travel?"

Winter Climate Delightful

This question is easily answered. The winter climate of Death Valley is delightful. There are only a very few days from the latter part of October until the middle of May when the sun does not shine. During these months the temperature seldom rises above 70 degrees, nor does it fall lower than about 20 degrees above zero. The winter climatic conditions are similar to those found in the Grand Canyon, except that in Death Valley snow is unusual.

For vividness of desert coloring and titanic grandeur, Death Valley is unlike anything else on earth—a thrilling revelation even to the most seasoned globe trotter.

With all that it has to offer to the tourist of the picturesque, Death Valley has remained in virtual obscurity for the same reasons that the Grand Canyon of Arizona remained in obscurity until the Santa Fé system built a railroad into it, erected hotels, and began its exploitation to travelers. Now the same thing is to be done with Death Valley, through the efforts of the Pacific Coast Borax Company—the corporation that turned Death Valley's gift to humanity into the avenues of commerce—and its associate organizations, the two local railroads.

The Tonopah & Tidewater Railroad will carry the tourist from Ludlow, Calif., on the transcontinental Santa Fé system, to Death Valley Junction, where a refinery now turns out the world's main supply of borax. From Death Valley Junction the Death Valley Railroad (narrow gage) is extended into the Funeral Mountains to the borax mines at Ryan, the probable site of one hotel. From Ryan it is now a motor trip of 18 miles down through Furnace Creek Wash to the floor of Death Valley and to Furnace Creek Ranch, established by the borax company for the purpose of retaining the only available water supply until such time as it might be needed for the development of near-by borax claims. The water there is brought in by aqueduct from two large springs in the Funeral Mountains, and in sufficient volume to irrigate 65 acres of land. This remarkable farm produces garden truck and three crops of alfalfa a year, which is used to feed cattle, producing beef for the miners at Ryan.

Most of the work at Furnace Creek is accomplished by machinery, since exacting physical toil by men and animals is out of the question. The labor is done by Indians innured to the conditions, under the direction of an educated foreman.

Under the present project of opening Death Valley to tourists, Furnace Creek Ranch will undoubtedly become the site of a splendid winter hotel, similar to the projected tourist resort at Ryan.

Two-Man Clipper Trims the Hedge Evenly

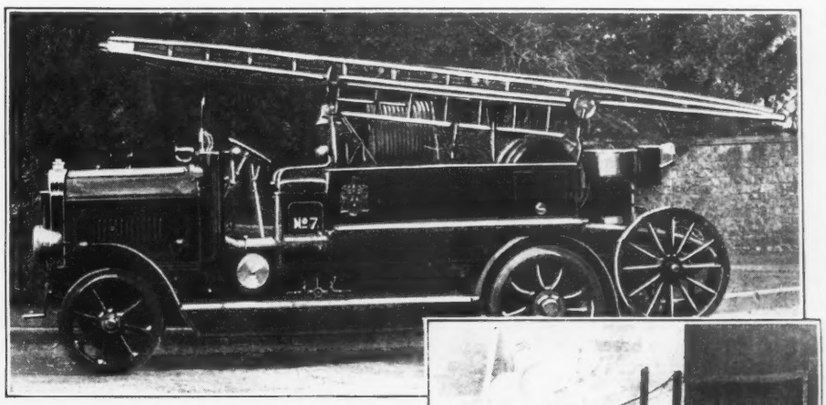
A HEDGE-CLIPPER made like a farmer's power mowing machine, consisting of a long bar with a saw-tooth blade that moves back and forth as the operator turns a hand wheel enables the hedge to be cut evenly by the amateur. It is said that the hedge of the average house can be clipped in less than half an hour, and that

This machine will clip the average hedge in half an hour

the operation is so easy that it may be cut every three weeks—as a hedge must be if it is to look its best.

As the bar extends entirely across the top of the hedge, it is impossible for it to cut unevenly. One person supports one end, and turns the wheel; the other holds the opposite end and walks parallel to the clipper, taking care to keep the bar horizontal. A shoulder rest from which the machine hangs vertically enables one man to make side cuts on hedges not exceeding 45 inches in height.

Novel Fire Engine Has Detachable Pump



The pumping mechanism is wheeled to the water supply, as inset shows

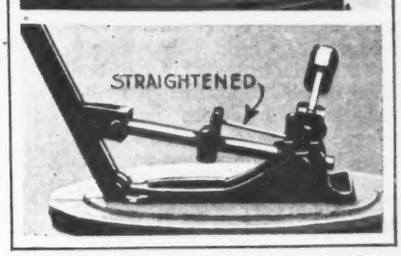
IN A newly designed electric fire engine developed by a British firm the gas engine drives an electric generator and this current is used not only to supply electric motors built into the rear axles of the truck, but also to drive the pumping mechanism.

This pumping mechanism may be detached and wheeled to any convenient point. This feature is important where the source of water is a river, a well, or a lake. The pump is a two-stage, high duty, centrifugal type, with a capacity of 300 gallons a minute.

Tool for Workbench Straightens Nails

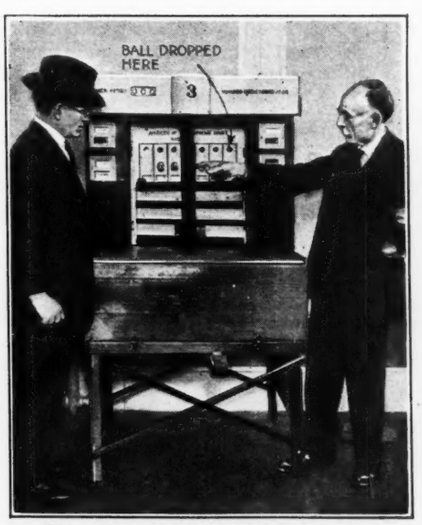
EVEN bent wire nails are being salvaged from the waste piles in Germany and restored to usefulness by means of an ingenious nail straightener that may be fastened to the workbench.

Hinged to one end of the cast iron base is a long lever with a handle. A few inches from the fulcrum of the lever an iron rod is hinged, and to this is attached a claw which grips the head of the nail to be straightened. The nail is placed with its head in the slot of the claw and with its body between the jaws of a straightening die which is operated by a lever. The jaws firmly grip the body of the nail and when the long lever is drawn back, the nail is pulled through the eye of the die and effectively straightened, as pictured below.



When the lever is drawn back, the bent nail is drawn through the eye of a die and straightened

Voting Machine Arrests "Repeater"



The voter casts his ballot by dropping a ball into a slot above his candidate's name and party emblem

A VOTING machine that is simple in construction, yet performs the complicated tasks of registering ballots, detecting and announcing frauds, and arresting the offender, has been designed by A. Niflot, of New York City.

The machine, containing no springs nor electrical mechanism, is operated by dropping a small ball into a slot above the candidate's name and party emblem. When this has been done, the candidate's appreciation is expressed by a sign that flashes a "Thank you" directly beneath his photograph.

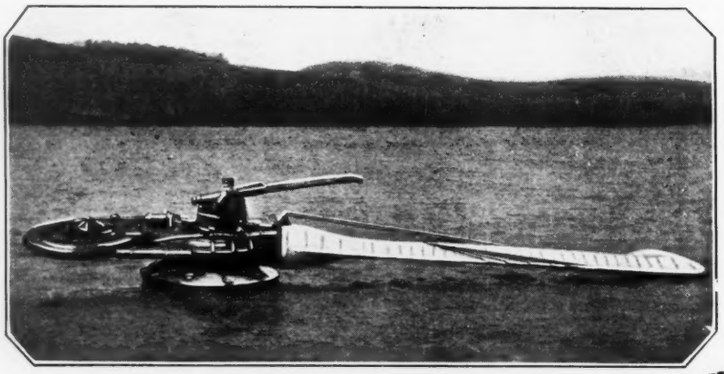
The voter who attempts to cast more than one vote for a candidate by dropping more than one ball in the slot is quickly detected. If two balls are inserted, the word "Fraud" appears outside the voting booth, a bell rings loudly and the would-be "repeater" is locked inside the booth until an inspector arrives. At the close of the voting period, a small lever, operated by the official in charge of the balloting, instantly reveals the vote.

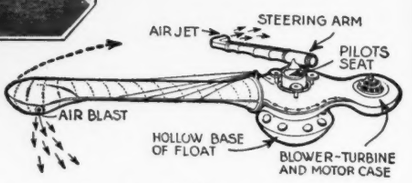
Will This "Whirling Leaf" Flying Machine Solve Greatest Problem in Aviation?

Vertical Flight Is Aim of Revolutionary Helicopter

HAVE you ever observed one of the winged seeds of the maple or sycamore making its way to earth after it has been detached from its stem? Whirling like a miniature wind wheel, the seed, describing a spiral as it is carried by the breeze, often travels hundreds of feet before it strikes the ground.

With this little gyrating seed as a model and reversing its actions, two French engineers, Papin and Rouilly, have recently developed a revolutionary type of helicopter, or vertical rising air machine, that is attracting the attention of aeronautical engineers, not because of any spectacular success as yet in rising from the ground, but because it represents an entirely new and logical line of attack on the obstinate problem of vertical flight.





Resembling a winged seed, the revolutionary Papin-Rouilly vertical flight machine, shown above, is driven by an air blast that, forced by a blower turbine through an opening near the curved end of the single hollow propeller blade, impels the blade in the opposite direction, as shown in the diagram at the right

That the perfection of helicopters for practical use, capable of rising vertically and descending in confined spaces such as on the roofs of buildings, is entirely possible, is the belief of aeronautical experts, among them Dr. Albert F. Zahm, expert for the United States Navy.

The Screw Propeller Type

Until the Papin-Rouilly model made its appearance, the screw propeller type of helicopter, three variations of which are pictured on page 25, was the basis for most experimentation. In general, this type consists of two or more propeller screws mounted horizontally either on an airplane fuselage or on a vertical shaft with engines, fuel, and passengers carried below. Equal numbers of horizontal propeller blades revolve in opposite directions so that the body of the machine may not spin like a top. The chief problems encountered by experimenters with these machines are the difficulties of flying the machines horizontally and getting them down out of the air safely. The most serious drawbacks have been the weight of the machines in proportion to engine efficiency and the inability to develop motors that can be depended upon to maintain the machine in the air without sudden failure; for, whenever the engine stops, the machine cannot glide to the ground, but tends to drop like a rock.

These handicaps Papin and Rouilly have sought to overcome by their remarkably ingenious machine of winged-seed shape, which they have named "gyropter," to distinguish it from other helicopters. In designing their model, they argued that if it were possible to reverse the motion of the winged seed, it would ascend, cutting its way through the air in screw fashion. A series of experiments soon convinced them that their theory was sound, and showed them that the perfection of a light, dependable vertical flight machine, acting as its own propeller blade, was within the range of possibility.

The Papin-Rouilly gyropter is in itself a single, whirling propeller blade, proportionally much longer than the blades of other airplane or helicopter propellers. This blade is attached to a ring-shaped body that surrounds and revolves around the cylindrical nacelle containing the pilot and forming the superstructure of the bowl-shaped body of the gyropter. The propeller is counterbalanced by a flat, circular casing that contains the motor and the blower turbine, which sends a blast of air under high pressure into the hollow propeller blade. The air, escaping near the curved end of the blade, imparts to the balanced propeller a rotating motion in the opposite direction.

The ring shaped member that forms the hub of the gyropter propeller, rests on ball bearings in a circular channel surrounding the pilot's nacelle, and is held in place by a flange of the bearing channel. The steering device consists of a wooden tube extending from the nacelle. The tube, through which the blower turbine sends a strong blast of air, ends in an L, which may be turned to any angle around the longitudinal axis of the tube.

The reaction produced by the blast issuing from the L of the tube not only prevents the nacelle and its substructure from participating in the gyrating motion of the propeller, but enables the pilot to steer the gyropter at will.

The base of the nacelle is hollow and will keep the machine afloat when it rests on the water. It is provided with rubber cushions that act as shock absorbers if the gyropter descends to solid ground. The machine weighs about 1100 pounds.

The gyropter was invented by Papin and Rouilly in 1914 and great things were expected from it. Unfortunately, the outbreak of the war interrupted the experimental work of the inventors. One of them was sent back from the front to continue the work of perfecting the gyropter which, it was hoped, would be of great value for military reconnoitering and observation, since it would be less bulky and conspicuous than the necessarily large observation balloons. The inventor was handicapped by the lack of competent workmen.

This view of the launching of the machine shows the arrangement of motor and blower turbine in a circular casing, counterbalancing the propeller blade. Between the casing and blade is the pilot's cockpit

Models Rise Readily

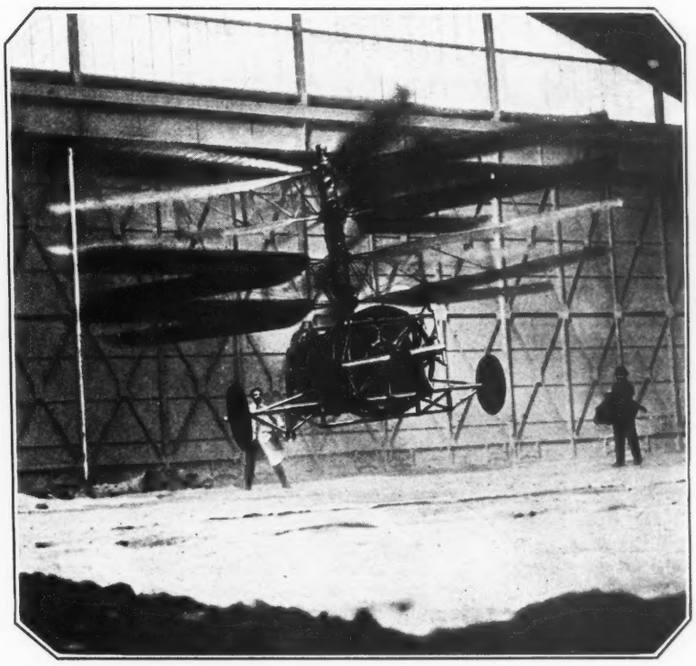
In spite of all difficulties, he succeeded, before his return to the front, in completing several small models that readily rose from the ground, but dropped when the fuses, supplying the motive power, burned out.

Not until last year did the inventors succeed in building a full size model, large enough to carry the weight of a pilot. The trials were not entirely satisfactory, for the machine failed to rise from the ground or the surface of the water. But the inventors are confident that their gyropter is based upon sound physical and mechanical principles and that its ability to rise in the air is merely a matter of equipping it with a more powerful engine.

These New Aircraft Lift Themselves Straight Upward

TWO or more whirling, horizontal propeller screws, resembling airplane propellers, to lift passengers, engine, and fuel vertically from the ground, have been the rule in recent experiments with helicopters of the screw propeller type, from which the "falling leaf" type of Papin and Rouilly, described on the opposite page, represents a radical departure.

Machines of the screw propeller class pictured on this page represent the most promising of the latest developments in helicopter design, and the most successful of the recent attempts to remedy the difficulties of practical flight.



Whirling in opposite directions, two groups of six biplane propellers, mounted one above the other on a vertical driving shaft, lift the Pescara helicopter to a height of four feet

Italian Progress

Real progress in solving difficulties of making horizontal flights and of preventing the machine from rotating with the propellers has been achieved by M. Pescara, an Italian engineer. His machine, recently constructed in Barcelona, Spain, with the financial support of the French military aeronautical service, is lifted by two sets of double-plane propellers, each similar in appearance to the wing of an airplane and arranged in groups of six, one group above the other on a driving shaft. To prevent the machine from rotating, the two sets of propellers rotate in opposite directions about the vertical propeller shaft, and are so arranged that the pitch of the blades may be changed as desired.

while the apparatus itself was almost stationary.

Among the most recent American efforts to accomplish horizontal flight is the helicopter designed by Emile Berliner of Washington, D. C., resembling an airplane without wings. On each side of the fuselage is a 14-foot propeller, while a three-foot propeller is placed near the tail. All three are geared to the engine so that the torque is transferred into a horizontal pull of about 25 per cent of the lifting power.

While the Berliner machine has never been higher than 12 feet from the ground, experimental flights at College Park, Md., have been encouragingly successful.

Considerable success also has attended trials of a captive helicopter, invented by Lieut. Stefan von Petroczy of the Austrian Balloon Corps. This machine consists of a three-armed framework of steel tubing supporting a central shaft bearing two airplane propellers, each 20 feet in diameter and driven in opposite directions at a speed of 600 revolutions a minute by gasoline engines of Le Rhone type, each capable of developing 120 horsepower.

At the end of each arm spherical pneumatic shock absorbers are fitted, with a larger shock absorber in the center for easing the shock when landing. Above the air screws is the cockpit accommodating two observers. Inside the cockpit is packed a giant parachute so arranged that it may be ejected and opened when the observer pulls a trigger, or the same result may be obtained by an automatic device controlled by the speed of the air screws, so that if the revolutions of the screws drop below a certain speed the parachute opens and the engines are stopped. The lifting capacity of the parachute supports the whole machine sufficiently for a safe descent without assistance from the air screws.

Resembling an airplane without wings, the Berliner helicopter is lifted by a 14-foot propeller on each side of the fuselage and is steered by means of a three-foot propeller at the tail

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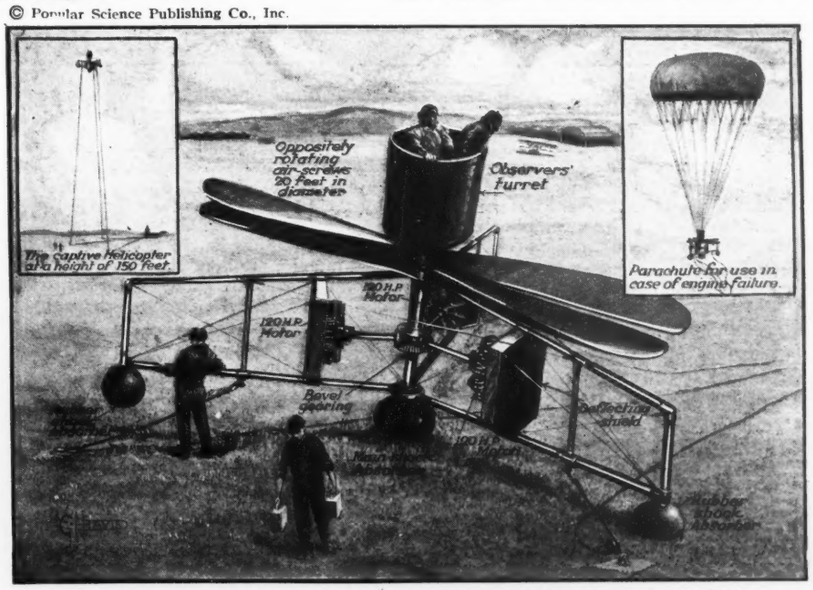
The captive Helicopter at a height of 150 feet.
Oppositely rotating air-screws 20 Feet in diameter
Observers' turret
Parachute for use in case of engine failure
120 H.P. Motor
120 H.P. Motor
Bevel gearing
Deflecting shield
100 H.P. Motor

Packed in the barrel-like cockpit of the Petroczy helicopter, pictured above, is a parachute capable of supporting the entire machine for a safe descent in case of engine failure

The helicopter superstructure rests upon a base resembling the chassis of a streamlined racing automobile, supported by rubber tired wheels. The fuselage of the car contains the gasoline engine of 36 horsepower. In recent preliminary trials the Pescara machine repeatedly left the ground and was maintained for several minutes at a height of four feet, while the apparatus itself was almost stationary.

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A Record Ascent

In tests the Petroczy machine has remained aloft for one hour and has risen to an altitude of 164 feet, with an average rate of climb of four feet a second, according to reports from Europe.

The offer of large prizes by the governments of several countries and organizations interested in the development of aerial navigation has induced many inventors to devote their genius to the solution of the helicopter problem. In the United States, Cooper-Hewitt built and tried out a number of models of his own invention with fair, but not convincing, success. Two French aviators, Damblanc and Lacoin, collaborated in developing a helicopter which, however, came to grief in the tryout. Another French inventor, Oehmichen, built a light helicopter driven by a 25-horsepower gasoline engine and stabilized by a hydrogen-filled balloon, with which he made several ascensions, landing without injury to his machine.

New Phonograph Built like Human Ear

Experts Amazed at Richness of Musical Reproduction Due to Resonating Wooden Rods

PROMPTED by a desire to preserve for future generations the art of the great singers of today, Charles A. Valentine, a banker of Yonkers, N. Y., has perfected an extraordinarily novel talking machine that reproduces in all their original beauty and quality the recorded voices of famous artists. A remarkable resonating system closely resembling the wonderful mechanism and preserving the delicate tone sense of the human ear, is the basis of the new instrument.

Uses Wooden Rods

Mr. Valentine's early experiments, seven years ago, convinced him that the outstanding imperfection in phonographs at that time was their failure to develop the overtones and so to reproduce the actual quality of the sounds created by the artist. With the knowledge that instruments and voices embodying the largest number of overtones are the most pleasing and effective, he worked out a system of resonant wooden rods, suggesting the so-called rods of Corti in the human ear, to vibrate in sympathy with the many overtones from the reproducing diaphragm of the phonograph and to amplify them so that they are no longer smothered. The result was the invention of Mr. Valentine's remarkable instrument.

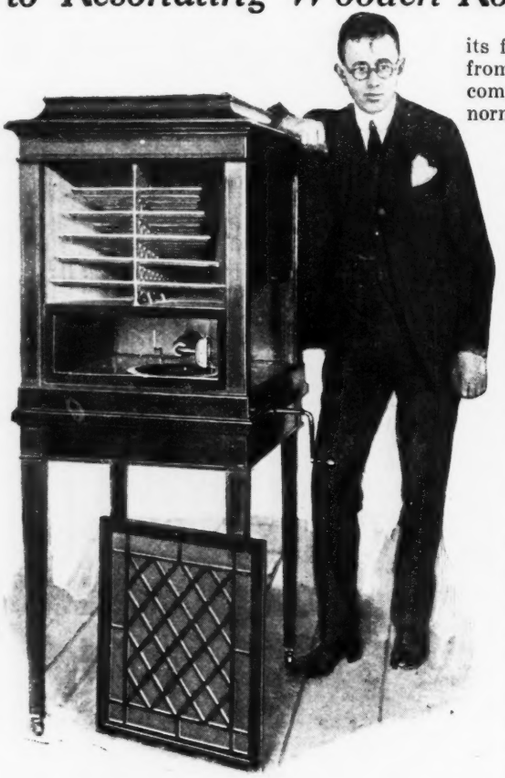
Perhaps the simplest example of resonance is the tuning fork, which, when struck while held in the hand, produces very little sound, but when set in motion and pressed against a wooden surface generates a sonorous sound of considerable volume. In producing the sound, the wood acts as an amplifier of the principal vibrations of the tuning fork. The quality and quantity of resonance vary with materials and methods.

Several years of constant experimentation were required before Valentine discovered the best method of obtaining the resonating effect he sought. Then his problem was to arrange the resonating members to give the desired result. He finally accomplished this by inserting a number of thin strips of specially treated wood in a metal support called the "septum," or partition, and attaching the septum to the top and bottom of the sound chamber of the instrument. When the resonator is in position, it occupies the entire opening of the sound chamber.

What Is Tone?

To pick up all overtones and vibrate sympathetically with them, the resonator must possess members responding to all the principal overtones encountered in musical selections. Each of the 7½ octaves of the piano is composed of eight full tones and five semitones. Each tone and semitone has its harmonics or overtones, produced when the principal tone is generated. The effect of the overtones can be readily gaged by comparing the tone from a piano having only one string with that of a piano having its full complement of strings. The tone from the single string will seem dead compared with the full tone from the normal piano. The full tone is created when sound vibrations from one string strike against other strings, setting up harmonic vibrations in them.

In the Valentine instrument from 60 to 120 resonating wooden strips, depending on the size of the machine, are exactly tuned to these various tones. The resonators of different lengths respond in sympathy with tones from the reproducing diaphragm and in so doing amplify the delicate overtones that otherwise would be completely smothered by the harsher full tones.



The Tone Recreator and Its Inventor

Resonant wooden rods, inserted in the phonograph sound chamber, vibrate in sympathy with overtones from the reproducing diaphragm, and so amplify the overtones of the record disk that otherwise would be smothered

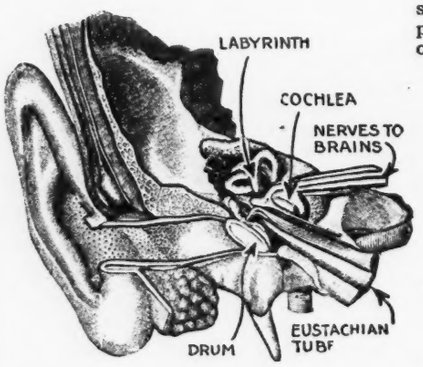
Like the Human Ear

The principle of Mr. Valentine's talking machine, while entirely new in musical instruments, has a near counterpart in the human ear. When sound waves strike the outer ear and are conducted through the outer passage or vestibule to the inner ear, they ultimately strike against the "organ of Corti." While the exact function of this organ is not definitely established, many theories have been advanced, most of them based upon the theory of resonance.

The organ of Corti consists of a membrane lined on both edges with parallel rows of heavier membrane, known as "rods of Corti." These rods bend at the top until they meet, thus forming in the angular space beneath,

How the Mechanism of Our Ears Reproduces Music

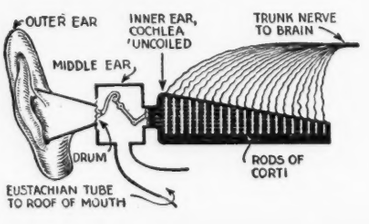
BY EMBODYING in the phonograph described in the accompanying article a device for reproducing every possible overtone, the inventor has sought to make the most of the complicated but beautifully efficient mechanism of the human ear.

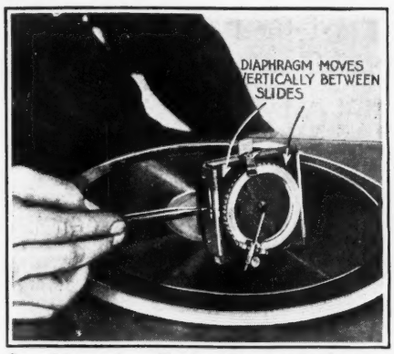


How a simple tone gets through the ear to the brain is made clear by the accompanying cut-away view and diagram. Hit by the sound waves, the drum of the middle ear imparts its vibrations, through a tiny system of bony levers, to a membrane in the wall of the cochlea. This organ looks like a snail shell, is filled with liquid, and contains within its convolutions thousands of what are called the "rods of Corti." As the liquid is agitated by a simple tone, the appropriate rod, or as some believe, the hair cells it supports, sends its impulse to the brain.

A much more involved process and one on which scientists are not agreed, is the sorting out and despatching through appropriate nerve channels of the many overtones that may come riding in with the fundamental tone. It is sufficient to understand that in the cochlea a complicated tone is resolved into its constituent fundamental and overtones, with a resulting impression in the brain of richness or other characteristic quality.

The diagram explains in an interesting way, also, how the Eustachian tube serves to equalize air pressure on both sides of the ear drum.





In this noise-eliminating reproducer, a wooden diaphragm with needle attached moves up and down with the record, while the tone arm remains stationary

an opening called the "canal of Corti." There are about 11,000 of these rods in each ear. Helmholtz expressed a belief that the rods were attuned to different sounds so as to vibrate in sympathy with them. Thus, when a complex sound wave enters the aural orifice, the rods that are properly attuned will be affected by the component tones and consequently will set up vibrations that are communicated by cells to the auditory nerve.

No Limit to Its Size

Mr. Valentine's invention is essentially a new musical instrument rather than an attempt to improve existing phonographs. Its adaptability to both home and auditoriums has been tested. A special auditorium model, in which the increased volume was created by 160 resonating strips and a large sized tone chamber, has been used successfully in a theater seating 1400 persons. The volume produced by this model is great enough to permit a pipe organ accompaniment. There is no limit to the size of the new instrument as it can be enlarged as desired merely by increasing the number of resonating strips, their dimensions, and the size of the sound chamber in which the resonator is placed.

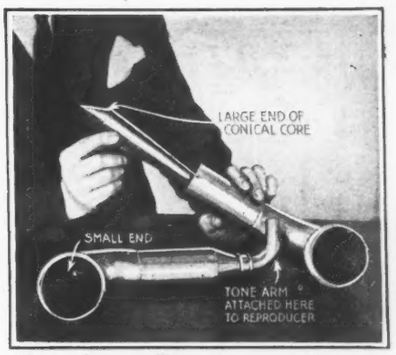
The pleasing tone quality obtained is partly due also to a unique wooden diaphragm in the reproducer that reduces extraneous and mechanical noises caused by the motion of the needle and reproducing mechanism. The needle holder is rigidly attached to this diaphragm, which slides up and down in an air-cushioned groove, but the tone arm itself does not move. This feature removes a considerable portion of the weight from the needle and increases the life of the record. Furthermore, the absence of metal in the tone arm eliminates objectionable "tinny" sounds.

The remarkable sensitiveness of the reproducer permits the use of the finest needle or a heavier needle when greater volume is desired. With an extra loud-toned needle an exceedingly large volume of tone is produced without injury to the tone quality.

How resonant wooden rods for amplifying overtones are assembled on a metal partition

After the grooves in the record are converted into sound waves by the vibrating diaphragm, these waves pass up through the wood sheathed tone chamber. As they expand they are forced to assume a "smoke ring" shape by passing around a tapering wooden core extending the length of the tone arm, which tends, the inventor believes, to mellow the tones. After reaching the end of the tone arm, the waves, now freed from many of the crude sounds, expand into the sound chamber, where they encounter the numerous resonating strips.

Each sound wave is made up of a multitude of single waves and each of the resonators within the pitch of the tune vibrates in sympathy with a tone corresponding to one of the single waves. Delicate but essential overtones that under ordinary conditions would be lost are thereby amplified by resonance to their correct intensity.



To produce mellow tones, sound waves, encountering a conical wooden core placed in the center of the tone arm, are forced into the shape of "smoke rings"

Used in Radio Broadcasting

By its power to recreate the voice of a Galli-Curci or the playing of a Kreisler in all their volume and mellowness of tone, the new Valentine instrument suggests important possibilities for radio reception and broadcasting. Radio experts seem to agree that the phonograph is destined to play an important part in future broadcasting of the world's best music. Indeed, combination radio and phonograph cabinets are appearing in increasing numbers.

The most serious drawback thus far in the use of the phonograph for radio has been the fact that the voice of a singer or the strains of an orchestra must pass through two distinct sound transferring operations before they reach the ears of the listener, and that, in these two steps, much of the original tone quality is lost. First the tones of the voice or instrument must be transferred to the phonograph record, and from there they must be transferred through the radio apparatus. The problem has been to find a means of transferring the original musical selection without distorting it in the process.

Automatic Tip Cart Dumps Its Load when Tractor Backs

WITH an ingenious new automatic tip cart that may be used with any tractor, the operator, without leaving his seat, can raise the end gate, dump the load, and replace the tailboard of the cart in five minutes.

Two small wheels that pivot and swing freely like furniture casters, support the tip cart. The upper end of each caster spindle carries a toothed rack that engages another rack on a rod connecting with the end gate. Since the load is transferred to the spindles well toward their tips, the wheels tend to lag behind the cart and the pressure thus created keeps the end gate in position.

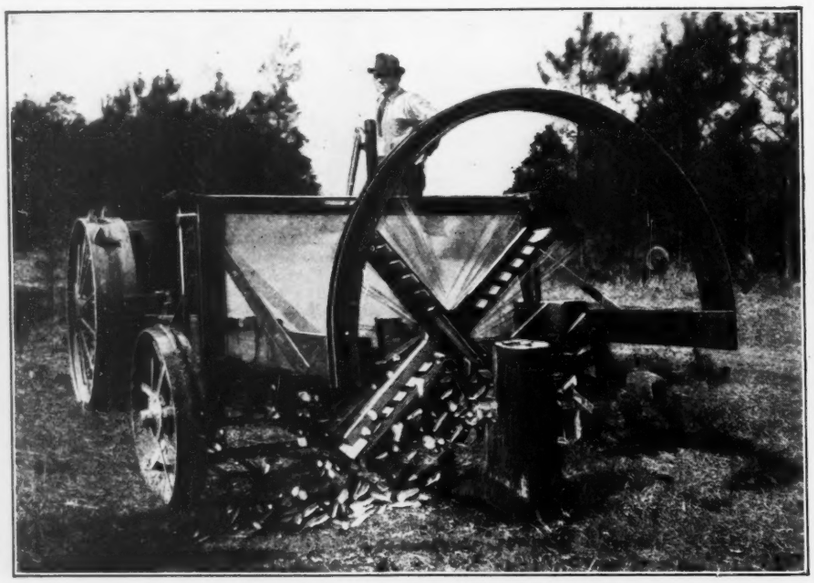
When the load is to be dumped, the tractor is stopped and the operator applies brakes to the tip cart wheels. He then reverses the tractor about two feet, and although the tip cart wheels cannot revolve, because of the brakes, the body moves rearward, pivoting on the wheels. This causes the gear segment on the spindle to move the segment on the end gate arm and lift the gate from its clips.

By this time the center of gravity of the load has been thrust beyond the center line of the wheels and the cart tips, dumping its contents. Still braking the cart, the operator drives the tractor forward, the cart tips back into place and the end gate drops into position for the next load.

Although the cart can be backed when necessary without prematurely dumping the load, the possibility of such an accident has led the makers to supply a pin that holds the rear body rigidly.

Insert shows mechanism by which the operator, braking the tip cart wheels and backing the tractor, dumps the load

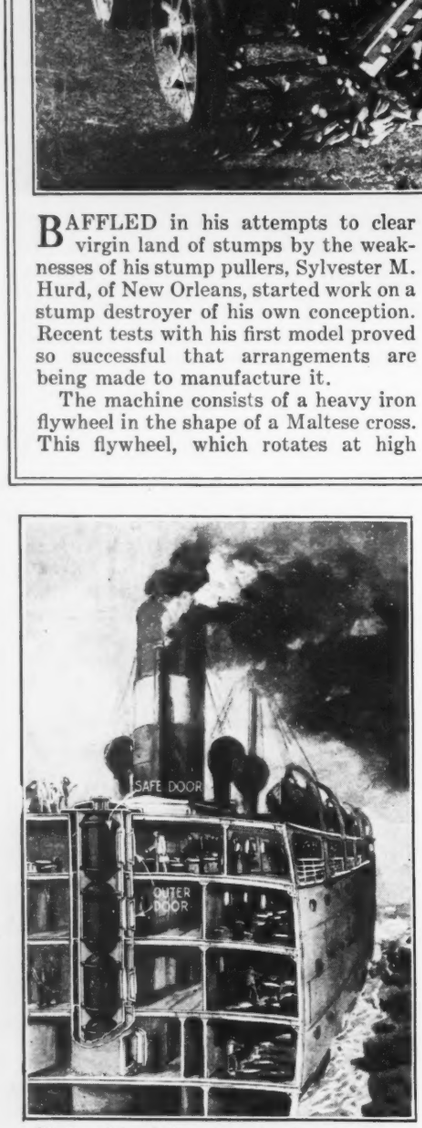
Whirling Blades Reduce Stumps to Chips



BAFFLED in his attempts to clear virgin land of stumps by the weaknesses of his stump pullers, Sylvester M. Hurd, of New Orleans, started work on a stump destroyer of his own conception. Recent tests with his first model proved so successful that arrangements are being made to manufacture it.

The machine consists of a heavy iron flywheel in the shape of a Maltese cross. This flywheel, which rotates at high speed, is studded on all four arms by steel plates. At the ends of the cutter arms are sharp knives that dig into the soil and cut the tap root.

In operation the stump destroyer is backed up to the stump and the cutter arm rotated by a gas engine. As the knives revolve they are gradually advanced into the stump. The wood is pulverized, as the fast swinging blades rip and tear the fibers.



If the ship sinks, the cylindrical safes, ejected through the tops of the shaft, float until recovered

Marine Safes Will Float if Ship Goes Down

A NOVEL method of equipping a ship with four or more floating marine safes that will release themselves if the ship goes down and will float, even if the doors are open, has recently been devised.

The safes, manufactured of triple steel, lighter than the water they displace, are mounted in a shaft or well that opens from an upper deck of the ship. Each safe is accessible to a deck through a door. The upper opening of the shaft is covered with canvas, so that in case of sinking the safes simply float out of the shaft as the ship goes down.

Thick walls and large blisters at the top and bottom filled with a light fireproofing material make the safe lighter than an equivalent bulk of water.

There Is Cash in Your Camera

THE next time you see something novel in the way of a new mechanical device or other scientific achievement that you think will interest POPULAR SCIENCE MONTHLY readers, take a picture of it and shoot it in.

Maybe your picture will win the first prize of $25 in POPULAR SCIENCE MONTHLY'S camera contest.

$50 in Prizes

awarded each month for the three most interesting photographs submitted. Prize-winners in last month's contest are:

FIRST PRIZE, $25—Anthony Robinson, San Marcial, N. M. Subject: "Machine Wields Shovel Like a Man" (see page 36).

SECOND PRIZE, $15—Dale R. Van Horn, College View, Nebr. Subject: "Bracket for Paint Pail Fastens on Wall" (see page 48).

THIRD PRIZE, $10—George G. McVicer, North Bend, Nebr. Subject: "Harvester and Thresher in One Machine" (see page 42).

Electrified Map Converts "Geography" into Game

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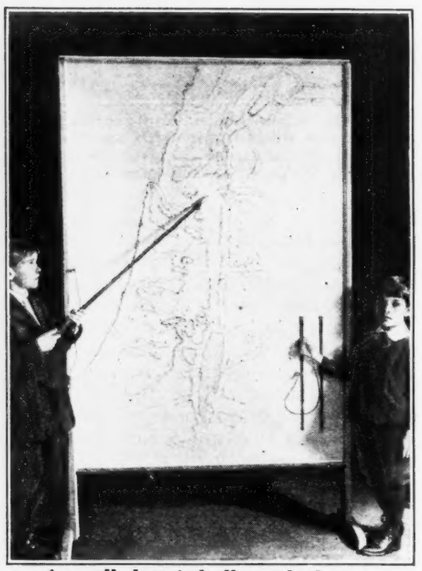

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28 Popular Science Monthly

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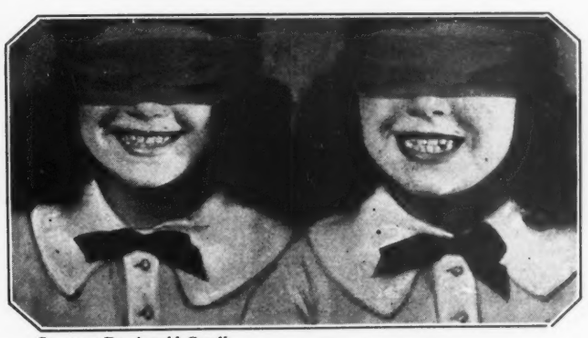
Twins in Mind as Well as Body



Courtesy Dr. Arnold Gesell

SITTING in separate rooms and told to draw a man and a tree with a bench under it, these "identical" twin sisters produced the remarkably similar freehand drawings shown here. Especially astonishing is the fact that among all the ways of visualizing the scene, the two children independently chose almost identical relationships between the three objects.

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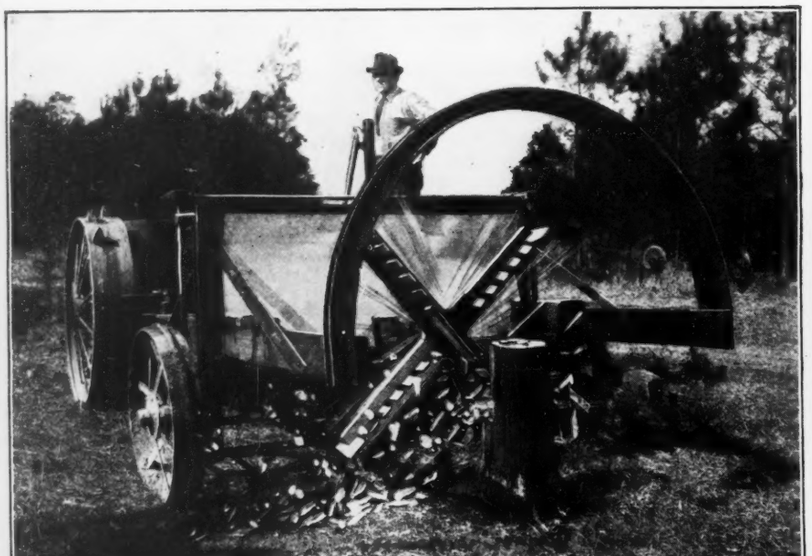
Whirling Blades Reduce Stumps to Chips



BAFFLED in his attempts to clear virgin land of stumps by the weaknesses of his stump pullers, Sylvester M. Hurd, of New Orleans, started work on a stump destroyer of his own conception. Recent tests with his first model proved so successful that arrangements are being made to manufacture it.

The machine consists of a heavy iron flywheel in the shape of a Maltese cross. This flywheel, which rotates at high speed, is studded on all four arms by steel plates. At the ends of the cutter arms are sharp knives that dig into the soil and cut the tap root.

In operation the stump destroyer is backed up to the stump and the cutter arm rotated by a gas engine. As the knives revolve they are gradually advanced into the stump. The wood is pulverized, as the fast swinging blades rip and tear the fibers.

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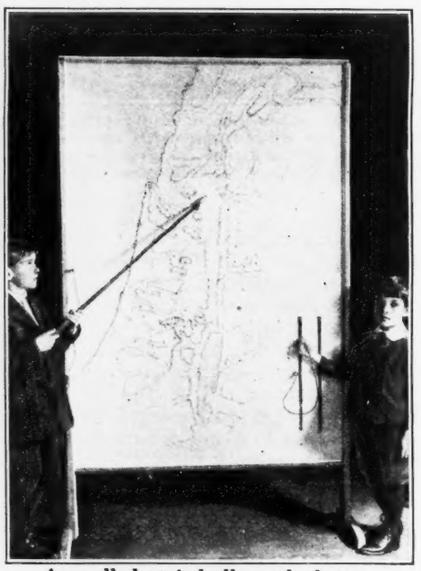

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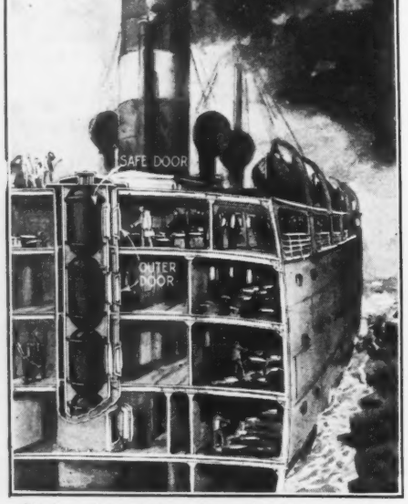

If the ship sinks, the cylindrical safes, ejected through the tops of the shaft, float until recovered

Marine Safes Will Float if Ship Goes Down

A NOVEL method of equipping a ship with four or more floating marine safes that will release themselves if the ship goes down and will float, even if the doors are open, has recently been devised.

The safes, manufactured of triple steel, lighter than the water they displace, are mounted in a shaft or well that opens from an upper deck of the ship. Each safe is accessible to a deck through a door. The upper opening of the shaft is covered with canvas, so that in case of sinking the safes simply float out of the shaft as the ship goes down.

Thick walls and large blisters at the top and bottom filled with a light fireproofing material make the safe lighter than an equivalent bulk of water.

There Is Cash in Your Camera

THE next time you see something novel in the way of a new mechanical device or other scientific achievement that you think will interest POPULAR SCIENCE MONTHLY readers, take a picture of it and shoot it in.

Maybe your picture will win the first prize of $25 in POPULAR SCIENCE MONTHLY'S camera contest.

$50 in Prizes

awarded each month for the three most interesting photographs submitted. Prize-winners in last month's contest are:

FIRST PRIZE, $25—Anthony Robinson, San Marcial, N. M. Subject: "Machine Wields Shovel Like a Man" (see page 36).

SECOND PRIZE, $15—Dale R. Van Horn, College View, Nebr. Subject: "Bracket for Paint Pail Fastens on Wall" (see page 48).

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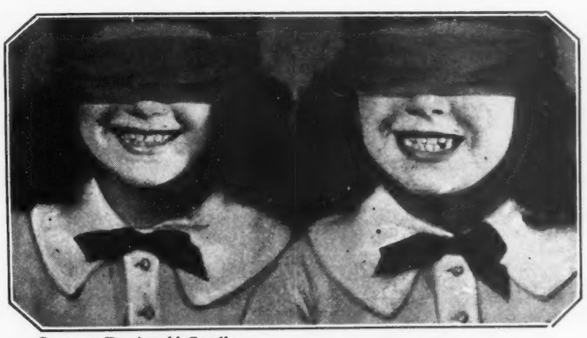

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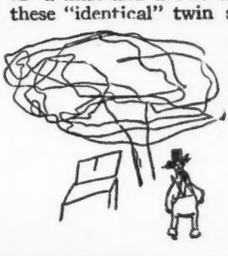

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In Justice to the Crystal Detector

Inventor of the Lowest Priced Type of Radio Receiver Tells How to Get Hundred-Mile Distances with It

"A STOPGAP of the past—only a beginner's plaything today." Thus you hear the experts speaking of the crystal detector—which, nevertheless, makes the greatest appeal in simplicity and economy to millions of radio users.

The father of the crystal detector himself defends, in the following interview, the brilliant possibilities of his invention.

This—the first article published by Mr. Pickard since America's radio boom—will undoubtedly raise a flood of vitally interesting debate.

By GREENLEAF W. PICKARD

Inventor of the Crystal Detector, now Consulting Engineer for The Wireless Specialty Apparatus Co.

In an interview for POPULAR SCIENCE MONTHLY

WITH a nine-turn loop aerial, three feet across, using a crystal detector and tube amplification, I have enjoyed loudspeaker reception in Boston of radio-phone broadcasts from Schenectady, 160 miles away. Likewise, with a crystal detector I have heard, on occasion, Pittsburgh, Detroit, and even Chicago. The distances covered in the latter instances range from 475 to 900 miles.

Knowing from long experience what a crystal detector, under the best conditions, actually will do; knowing in what respects it is superior to a tube detector; knowing, also, the key rôle it has played in radio history, I cannot help wondering at a recent tendency on the part of some to speak contemptuously of it.

In fact, I believe that the future of radio in the American home lies with the crystal detector. Already we can confidently estimate that of perhaps 2,000,000 receiving sets in the United States, a majority use galena for detection. It is ideal for the beginner. It is invaluable for emergency and portable sets. Government radio stations constantly keep crystal detectors in reserve.

Where the "Knocks" Originate

Many of the uncomplimentary remarks now current concerning the crystal detector may originate with the old-line amateur—the man who has worked with radio from the beginning, for the sheer pleasure of it, and who is, perforce, the counselor of the beginner today. He has found the vacuum tube much more to his liking; he associates the crystal with the "ancient" days of radio; he is himself expert enough to use with maximum success the tube detector. Hence he spreads the gospel that the tube is the only thing.

Yet the radio novice doesn't know what real trouble is until he graduates from the crystal detector to the tube. His case is exactly the same as that of the beginner in photography, who gets excellent results with a cheap and simple snap-shot outfit, but who fails disastrously when he first tries to use more expensive and delicate cameras.

Within the traditional 20 to 30 miles of a broadcasting station, a new radio-phone enthusiast should have the best results he could wish for from a crystal set. An ever increasing number of broadcasting stations is almost certain to be established within the next year, and we may confidently expect, therefore, that hundreds of thousands of homes, now still remote from radio centers, will soon be within this "normal crystal detector range" of some new station. Of course, you cannot hope to operate a loudspeaker with a crystal detector, unless one or more amplifier tubes are added. But the average loudspeaker set, with its noises and distortion, is even less pleasant to hear than the phonograph of twenty years ago, whereas the crystal detector and head phone outfit is entirely free from distortion and noise.

It is significant that a standard set is now making its appearance, which can be bought in units, with only crystal detection at the start, units giving radio and audio frequency amplification being added later.

G. W. Pickard in his Boston laboratory

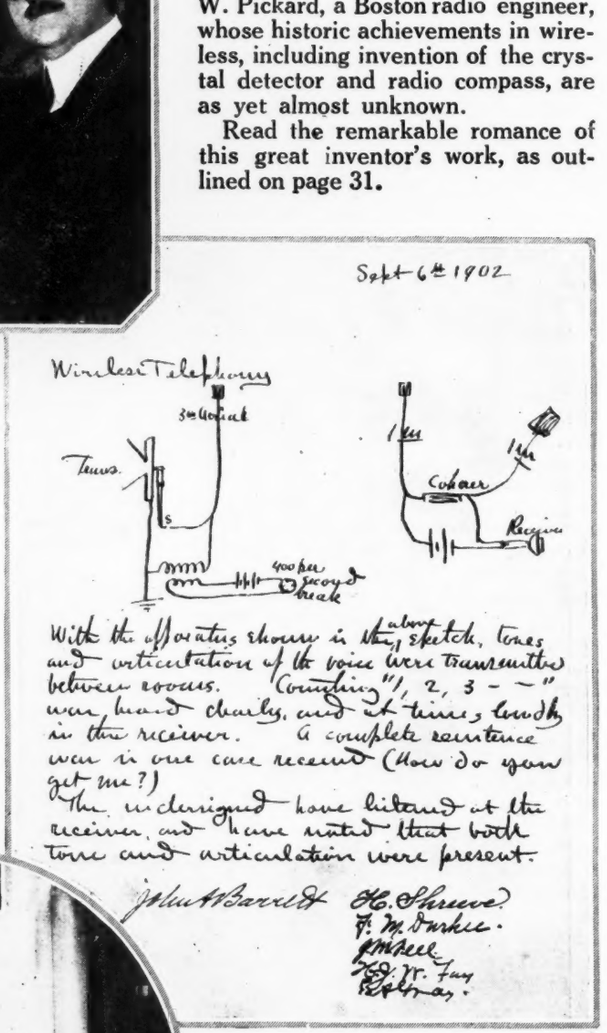
DO YOU know that the first radio-phone transmission of a spoken sentence was accomplished just 20 years ago?

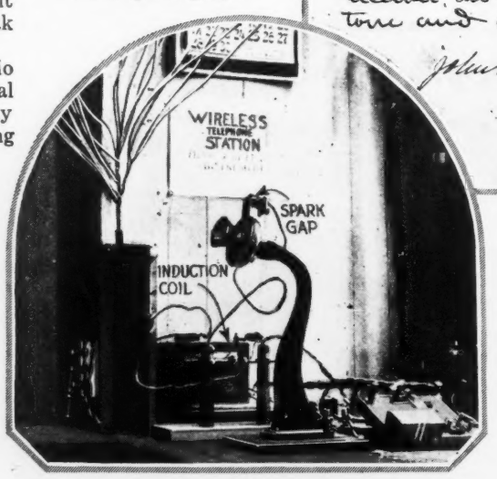
Claimant to the honor is Greenleaf W. Pickard, a Boston radio engineer, whose historic achievements in wireless, including invention of the crystal detector and radio compass, are as yet almost unknown.

Read the remarkable romance of this great inventor's work, as outlined on page 31.

Was This the First Radio-Phone?

At right, reproduction of Mr. Pickard's original notebook memo, describing his apparatus with which, 20 years ago, what is said to have been the first radio-phone transmission of speech was accomplished. Six witnesses vouched for the successful functioning of the apparatus as sketched in the note and shown below in a hitherto unpublished photograph


Sept 6th 1902
Wireless Telephony
Coherer
Receiver
With the apparatus shown in the above sketch, tones and articulations of the voice were transmitted between rooms. Counting "1, 2, 3 - -" was heard clearly, and at times, words in the receiver. A complete sentence was in one case received (How do you get me?)
The undersigned have listened at the receiver, and have noted that both tone and articulation were present.
H. C. Shreeve
F. M. Burke.
J. M. Keel.
Geo. W. Fay
Boston.



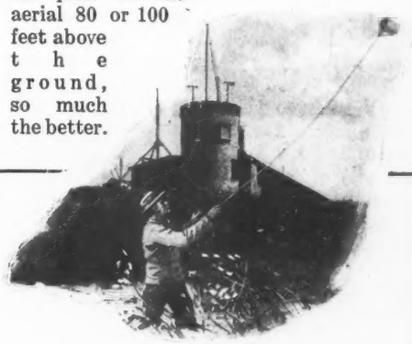
In this primitive outfit, having a sparking frequency of between 5000 and 20,000 a second, modulated transmission was effected by changes in length of the tiny spark gap attached to the vibrating diaphragm

"THE crystal detector," says its inventor, G. W. Pickard, in this important article, "may be most effectively used in E. H. Armstrong's marvelous new super-regenerative circuits." Jack Binns further describes Armstrong's great invention and discusses its future possibilities on page 70.

As to reception over greater than the "normal" distances, I share the caution of others in not wishing to raise expectation too high. Yet I do believe that, under favorable conditions, with an excellent aerial and an efficient tuner, crystal detector reception up in the hundreds of miles need not be considered unattainable.

It is interesting to recall, by the way, that in distance of reception we are little in advance, today, over the records of 14 years ago, when, for instance, our fleet off Cape St. Roque received daylight messages from North Atlantic coastal stations, using the silicon detector. In the vital war months of 1917 and 1918 at the Otter Cliffs Naval Radio Station near Bar Harbor, the greater part of our short wave reception was accomplished by a combined crystal detector and two-stage amplifier, and it was not uncommon for us to read low-power ship sets in the English Channel with the "phones on the table."

In amateur reception today, the problem of the aerial, although constantly harped on by radio writers, is still not taken seriously enough. Use of vacuum tube amplification has increased our tendency to neglect the aerial—and the consequence has been much avoidable annoyance and expense in many a beginner's receiving station. The ideal aerial should be at least 40 feet above the ground, and from 150 to 200 feet long. If it is possible to elevate the horizontal part of the aerial 80 or 100 feet above the ground, so much the better.



One of the first radio stations in the United States—Blue Hill Observatory, Mass., where Mr. Pickard's kite-flying experiments in 1898 opened a remarkable wireless career

An Untold Romance of Invention

By S. K. Hibbert

BUT for an odd accident that happened to Greenleaf Whittier Pickard—radio engineer—one spring morning at Cape May, N. J., in 1902, the amazing era of wireless progress through which we have just passed might have been set back dozens of years.

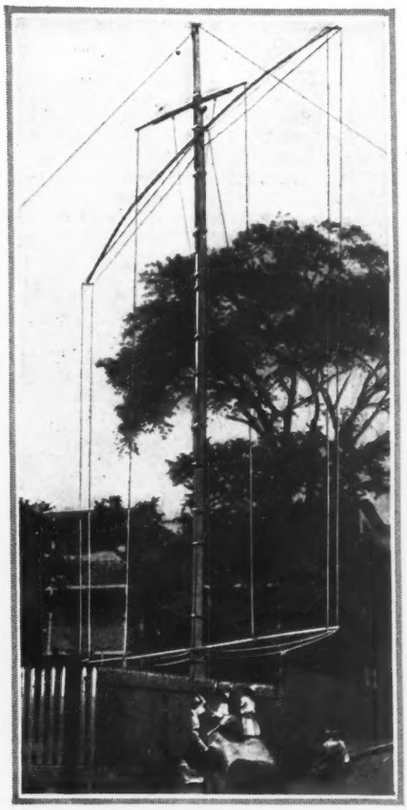
Inventor of the crystal detector, and a notable figure in recent radio history, whose real contributions to the present situation are yet almost unrecognized by the general public, Mr. Pickard has had a career that fits with amazing fidelity the traditional scenario of the great American "success" story.

A grandnephew of the poet Whittier, the future radio inventor knew in his early days the inky life of printer's devil, on the Portland, Me., *Transcript*, his father's newspaper. And later, as in all good romances of this kind, from Benjamin Franklin's down to date, the youthful Pickard not only wrote parts of the paper, but set type on his own copy. Later, and again like Benjamin Franklin, he took to flying kites in the interest of science. This was after a college course, during which chemistry and a complicated geological theory preempted the youthful Pickard mind. It is strange that one of the most notable joint creators of the vast radio industry of today should have entered that particular field of endeavor through an effort to help future generations—literally a thousand years, or more, hence—determine if the ice ages of hundreds of thousands of years ago were caused by variations in the carbon dioxid content of the earth's atmosphere.

A Genius for Wireless

In pursuit of the facts that, when tabulated through countless generations, would help prove or disprove this particular hypothesis, Pickard, fresh from Massachusetts Institute of Technology, went to the Blue Hill Observatory, Milton, Mass. While he was there engaged in fishing down the secrets of the upper air with kites, the Smithsonian Institute asked the Blue Hill Observatory to conduct experiments that would show the effect of aerial height on wireless transmission. Pickard being on the ground, was thus, by accident, drawn into wireless work. So marked was the genius that he showed in the succeeding experiments, that a few years later the American Telephone and Telegraph Company, anxious to develop, if possible, a wireless telephone, called him to help in their laboratories. And it was in the Bell Telephone Company offices—Milk Street, Boston—that on September 2, 1902, Mr. Pickard uttered into his own primitive, weirdly conceived transmitter what is said to have been the first spoken sentence ever transmitted by radio. No historic phrase was his. "How do you get me?" he said. They got him well; tone and modulation were good.

Somewhat earlier, Mr. Pickard had directed the establishment of a wireless telegraph station at Cape May, N. J. And here it was that, on May 22, 1902, he made, by sheer accident, plus an observant eye and keenly thoughtful mind, his most famous discovery. He was working that day with a detector consisting of fine sewing needles laid lightly across a pair of carbon blocks, in series with three cells of a dry battery and a telephone receiver.



The world's first radio compass, operated successfully in 1907 by G. W. Pickard at Dorchester, Mass.

"Being exasperated by the microscopic 'fry' of my detector," he relates the incident, "I attempted to check the annoyance by cutting out two of the three dry cells. The signals continued to come in, weaker, but clear. Suddenly, to my utter amazement, as I glanced over the apparatus I discovered that I had cut out not two but all three dry cells! My telephone diaphragm was being operated solely by the energy received on the aerial! Nobody believed at that time that such a thing was possible."

Birth of the Crystal Detector

Here was the accident that resulted in the development of the crystal detector as commonly used today. Followed brain work and incredibly patient effort. Handling two jobs in Boston in the daytime, and working at home late into the night over his own experiments, with only five hours' sleep in 24, for months on end, Pickard not only developed the crystal detector as we know it now, but carried on a wide range of other wireless work, in the course of which he erected the world's first radio compass—a huge and gawky affair, nearly 20 feet on the side. A United States Navy officer was sent to inspect it, and was inclined to scoff at its size. "How could we use an affair like that on shipboard?" he asked. Pickard, undaunted, continued his radio compass work, and later perfected the first portable loop aerial.

It is an interesting fact that from 1906 on, the inventor's radio laboratory was established in the old home, at Amesbury, Mass., of another famous man of the same family—John Greenleaf Whittier.

Meanwhile, as a result of the Cape May accident, Mr. Pickard was carrying on his experiments with minerals that in contact would prove to serve as detectors for radio signals. He tried out literally thousands of substances, and discovered about 250

(*Continued on page* 90)

With aerials of much greater length than this, however, it is not possible to tune down to the present broadcasting wave lengths.

A clamp on the water pipe near its entrance—*not* on the radiator—is about the best ground connection you can have. If you are fortunately enough placed to have an aerial of this type, and to be able to keep it away from trees, bushes and buildings, you may reasonably hope for better than average reception on crystal detector sets. It is significant that most of the reports of remarkable distance records come from small towns where presumably a long, well-placed aerial can be erected.

Much Depends on the Tuner

Next in importance to the aerial is the type of receiving tuner that should be employed. For effective short-wave reception one should avoid all forms of tuner in which, when adjusted for amateur or broadcasting wave lengths, there is any considerable amount of winding not in circuit. Such unused wire, often called the "overhang," gives rise to dead-end effects, which usually seriously weaken the signals.

Why some amateurs with crystal sets can hear radio broadcasts over hundreds of miles, while others cannot hear a station 30 miles away, is still largely an insoluble mystery. In my own experience I find that, while I easily pick up Schenectady—an unusually powerful station, of course—signals from the nearer station at Springfield, Mass., are uncertain. In fact, tests have shown that they begin to fade about 15 miles from Springfield, in the direction of Boston.

It is quite possible that high resistance in the surface soil accounts for this. When the ground around Springfield is soaked by a heavy rain, I have found the reception is noticeably better.

As a general thing, about all we can say is that the greater success of one amateur over another—their sets being equivalent—is to be accounted for largely by local topographical and atmospheric conditions. The swinging or fading effect you so often notice in received signals is probably the result of rather local atmospheric conditions—probably within fifty miles of your own station.

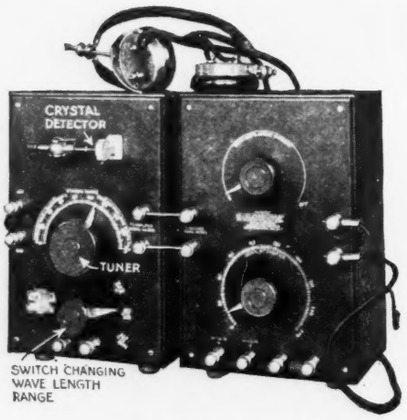
I have often noticed, for instance, that simultaneous signals originating in Chicago, Pittsburgh, and Newark go through exactly the same phases—indicating that the cause of the fading, in my case, is local to Boston.

Radio Wave Chutes

Again, many unusual successes in hearing distant broadcasts may be traced to the proximity of a body of water. As long ago as 1908, while mapping wave fronts from my transmitting station in Amesbury, Mass., using the world's first portable loop aerial, I demonstrated conclusively that streams of water act like radio wave chutes, concentrating the signals. A valley also will often act as a natural wave chute, and there sometimes appears a reinforcement of signals at or near the junction of sea and land.

Variations in the quality of the galena used in crystal detectors, of course, also accounts in part for the greater sensitiveness of some sets than others. An unusually sensitive crystal is something to be eagerly sought and carefully treasured. Ninety per cent of the ore we mine is discarded at once, as unsuitable for detectors, and in the manufacture we often emerge, finally, with only a few pounds of usable fragments to the ton.

Whether or not local conditions make crystal reception abnormally good in your vicinity, I believe it safe to recommend starting in with a crystal set, or, if you already have a tube detector set, adding a crystal detector to your equipment, for its greater efficiency and portability.



This medium priced new radio receiving set consists of two units. The one at right, which can be added any time after the purchase of the detector unit at left, contains four tubes giving both radio and audio frequency amplification

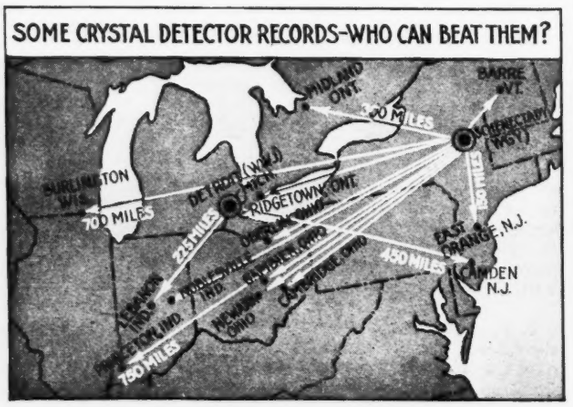
The Ideal Set for the Home

In fact, as I have said, the ideal radio receiving set for the home will ultimately be found to comprise multi-stage radio frequency amplification, a crystal detector, and one or more stages of audio frequency amplification. No progress yet achieved in radio invention has made me modify this opinion. If "wired wireless" broadcasting becomes common, the crystal will still be the cheapest and clearest detector for use with it. The positively phenomenal

(*Continued on page* 90)

Home Made Sets with Unusual Ranges

Correspondents of POPULAR SCIENCE MONTHLY, located in the towns indicated on the map at right, report reception on crystal detector receiving sets of broadcasts proceeding from the General Electric Company's Schenectady station and from the Detroit "News" over the remarkable distances shown



WHILE the average user of a crystal detector receiving set seldom hears broadcasts from stations more than 15 or 20 miles distant, a number of radio amateurs have described in recent letters to POPULAR SCIENCE MONTHLY instances in which they have heard radio-phone broadcasts from hundreds of miles away.

The location of their stations and approximate distances of reception are shown on the above map.

Their reports are of particular interest in connection with the article by G. W. Pickard published in these pages.

POPULAR SCIENCE MONTHLY wants to hear from readers who can show crystal detector reception over still greater distances.

Some of our correspondents give descriptions of their sets and hints as to the reasons for their remarkable records.

LAWRENCE BERNERT, Burlington, Wis., writes:

"I attribute my success in hearing music and talks over a distance of 700 miles from WGY (Schenectady) to a very sensitive spot on the galena, a good aerial ground, sure connections, and fine tuning.

"My aerial is of the inverted 'L' type, 70 feet long and 50 feet high, four wires spaced 18 inches apart, with a lead-in of 20 feet. My ground connection is made to the radiator and the water main."

VIRGIL KOLB, Princeton, Ind., writes:

"My installation consists of a home-made loose coupler, a 43-plate Murdock variable condenser, and a Great Lakes mineral detector.

"My aerial is of the three-wire 'T' type, suspended between a sycamore and a maple tree, 132 feet long and 35 feet high.

"When I first heard WWJ, Detroit, Mich., about 330 miles away, I had a 1000 ohm Brandes single receiver and a one-wire aerial, which was 75 feet long and 25 feet high. The music came in clear, and the announcements were perfect.

"Then I put up a three-wire aerial and heard WGY, Schenectady, N. Y., the first night, just as clearly as I heard WWJ. This of course was early in the spring, when static was not so bad, but I still can hear music when the atmospheric conditions are good.

"I can't account for hearing this long distance unless it is due to the fact that there is positively no leak to my aerial and the wires connecting the secondary circuit are bare. The variable condenser is used in the secondary circuit. The ground wire is attached to a copper pan about two feet in diameter, sunk three feet into the ground."

As in nearly every other case, HERBERT GIFFIN, of Gambier, Ohio, attributes his success to his excellent aerial. He writes:

"I am using a 'Duck' navy type receiving transformer, fixed condenser, Murdock .001 mfd. variable condenser, galena detector and Murdock 2000-ohm phones.

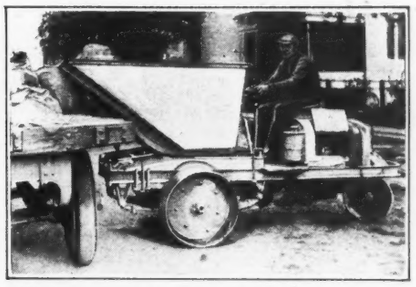
"My aerial is two wires 160 feet long, spaced four feet apart and 40 feet high, of inverted 'L' type, and to its length many people attribute my long range reception. I have heard WGY (about 500 miles) and KDKA (Pittsburgh, about 130 miles)."

Three-Wheeled Truck for Road Building Runs Backward

CEMENT contractors and road builders are now speeding up their work in several localities by another adaptation of the industrial truck which appears this time as a small three-wheeled unit that runs backward and will handle materials very rapidly over any ground.

A self-dumping body holding one cubic yard qualifies the unit for contracting work. The broad tires enable the truck to work over soft ground without danger of being mired and the three wheels have been adopted after much experiment because they permit the truck to make shorter, quicker turns and work in the confined space of excavations as well as on such jobs as road building. As the unit is small, a 30-horsepower engine gives it adequate power.

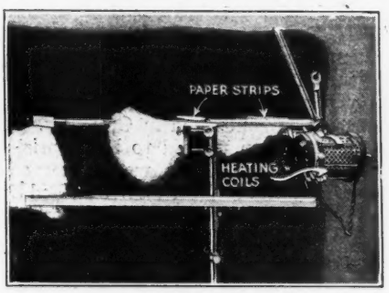
The chief use of these trucks is to haul cement and aggregate from the large trucks direct to the mixer. No shoveling is necessary on jobs where these units are used if full advantage is taken of their capabilities. Cement, sand, and crushed stone are dumped into the body directly from the large trucks, and carried to the hopper of the concrete mixer.



Above: Loading material from a large truck. At the right: Dumping the load into the hopper of a concrete mixer

Tempered Air Massages Suffering Patients

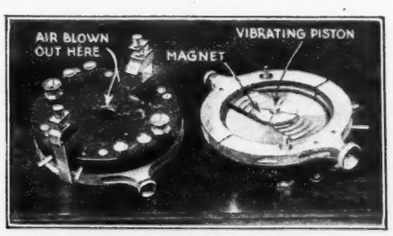
MASSAGE by powerful vibratory air currents propelled by a magnetic motor is the latest means of therapeutic cure invented by Dr. E. C. Miller, of Zurich, Switzerland, for cases where the pain is so acute that the slightest mechanical contact is intolerable.



Vibrating paper strips show the effect of rapid, intermittent air blasts

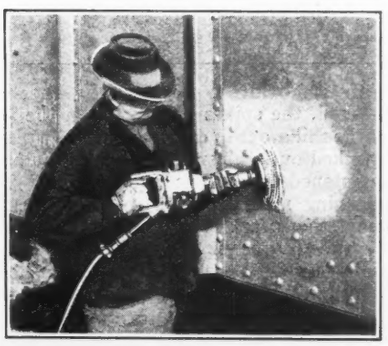
The air waves are intermittent, and of varying temperatures and the impact upon the skin is said to be highly soothing.

The air currents are produced by a tiny piston under the action of a fluctuating electromagnetic field formed by an alternating current of high frequency. The piston moves at the rate of 100 strokes a second in a cylinder open at one end.



The cover has been removed to show the vibrating piston

On each stroke, as the piston is attracted by the magnetic field, air is drawn into the cylinder, and is promptly expelled when the reversal of the field forces the piston outward. The stroke of the piston is only about one-eighth of an inch, but the rapidity of vibration is such that the air waves combine into an intermittent air blast.



Rotary Wire Brush Cleans Metal Surfaces

A CIRCULAR steel wire brush rotated by compressed air at a speed of 4200 revolutions a minute has been found effective in cleaning scale, corrosion, and dirt from metal surfaces.

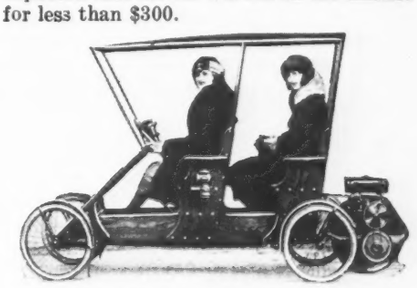
The air motor consists of three cylinders enclosed in the handle housing. By using an aluminum casing reenforced with steel bushings it has been possible to reduce the total weight of the brush to 14 pounds.

Steel box cars with a surface area of 1400 square feet were cleaned by a six-inch brush in 7½ hours.

Light Car Makes Eighty Miles to the Gallon

WEIGHING only 175 pounds, including the motor drive wheel, a new two-passenger motor car is able to maintain a speed of 30 miles an hour with gasoline consumption of 80 miles to the gallon. The car is only 35 inches wide with a tread of 30 inches and an overall length of 108 inches. The height of the car with its top up is slightly over five feet.

The sides and frame of the car are made of wood and the spring suspension is a derivation of the old-time buckboard. It is expected that the car will sell on the market for less than $300.



This midget motor buckboard, weighing 175 pounds, travels 30 miles an hour

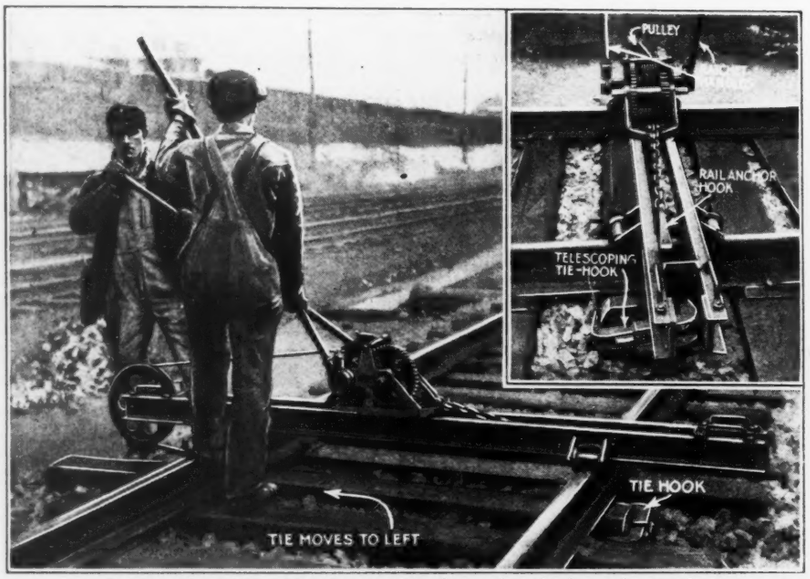
Boat Can Be Rowed in Three Sections

A ROWBOAT that can be broken into three parts, each of which is a watertight and navigable craft, has been invented in Provincetown, Mass.

The hull of the boat is in three parts, and each is closed by a small wooden bulkhead. Ordinarily, the parts are held together by iron pins fitting in the holes of a lock joint connecting the sections.

The purpose of the invention is not to make the boat unsinkable, so much as to provide a craft for summer "stunts."

Replacing Ties Now a One-Man Job



Ratchet handles, turning a gear, draw the tie from beneath the rail by a cable attached to a hook at one end of the tie

WITH the aid of a machine recently designed to extract and lay railroad ties, one man can remove a defective tie embedded in stone ballast and put a new tie in its place in 24 minutes, completing work that formerly required one hour and 12 minutes of his time. Two men, working with the machine, can replace more than five ties in one hour without disturbing the roadbed. This represents an estimated saving of $80 a year for every mile of track.

The total annual saving effected by the machine may be realized from the fact that more than 10½ per cent of the ties on which the rails of our railways rest must be exchanged for new ties each year. The number of ties to be renewed on American railways during the present year will exceed 90,000,000.

In removing a tie by the machine method, the spikes holding down the foot of the rail are first drawn and the tie plates knocked out. Then a telescoping tie hook is fastened around one end of the tie. The changing machine is placed on the rails above the tie and is securely braced against the rails by means of an anchor hook. A pulling cable is attached to the tie hook, passed under the rails, around a pulley and to the pulling gear equipped with ratchet handles. When the gear is turned by the handles, the tie is pulled to the side from under the rails.

To put the new tie in place, the action of the machine may be left as it was during the pulling operation, or it may be reversed, if the new tie is to be moved in place from the opposite direction.

Phonograph Alarm Wakes Sleeper with a Tune

"WAKE me up with my favorite record" may yet become the good night request if an interesting clock invented by Joseph M. Andre, Jr., of Brockton, Mass., comes into general use.

The clock consists of a cabinet containing a complete phonograph mechanism and an alarm attachment connected with the brake of the talking machine. At night the record is placed in position and the alarm set for the rising hour. At the designated time, the sleeper is awakened by the tuneful melody of his favorite record.

At rising time the clock starts the record

Nitrogen as Tire Filler

THAT tires filled with nitrogen will maintain their hardness for more than a year on cars driven thousands of miles over country roads was demonstrated in recent tests conducted in Germany. Loss of the nitrogen proved to be surprisingly small, and the rubber was preserved in better condition than that in air filled tires.

Tires filled with pure oxygen deteriorated very rapidly in the tests, indicating that oxidation is largely responsible for the destruction of automobile tires.

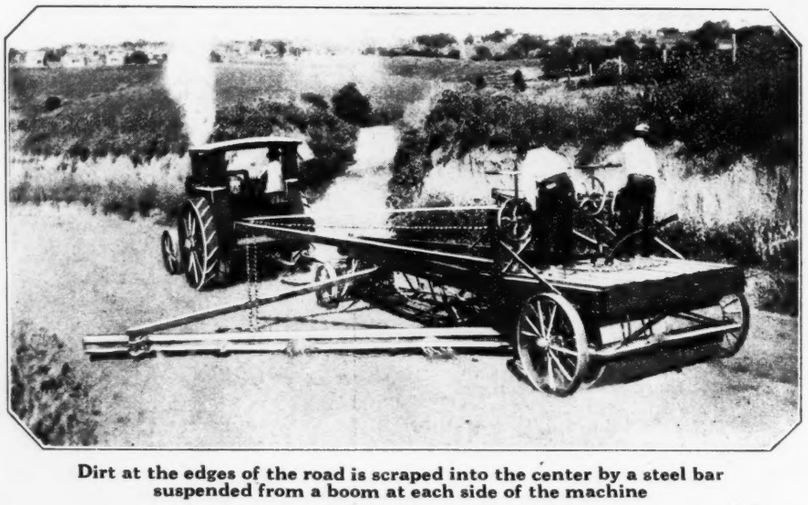
Spring Fastener for Belt Takes Up Slack

WHEREVER small machines driven by round leather belts are in use, a new and ingenious belt fastener will be found preferable to the old style fastening in which a hole was punched in each end of the belt and a hook inserted.

The new device consists of a spring connected with a split ferrule that is slipped over the end of the belt. The enlarged ferrule ends are then forced down into the leather, and a permanent connection is made, since the spring takes up slack.

A split ferrule with spring is slipped over the end of the belt

Roller and Scraper Combined for Roads



Dirt at the edges of the road is scraped into the center by a steel bar suspended from a boom at each side of the machine

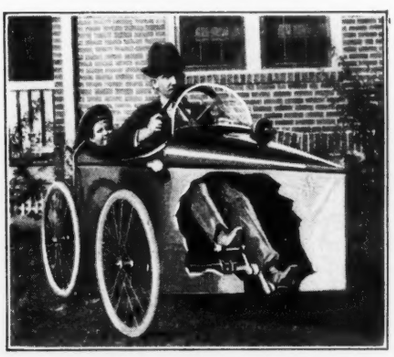
HAND labor in making country road repairs is almost eliminated by a new machine that collects its own dirt as it advances, and rolls it into a compact surface. A steel bar suspended from a boom at each side of the combined road scraper and roller scrapes up the excess dirt at the edges of the road, and leads it into the hollow usually worn in the center. As this depression is filled in, a heavy roller in the rear of the machine packs the dirt solidly.

The height and angle of the scrapers can be varied by hand wheels, so that the road can be finished with any contour desired. Unusually smooth roads, it is said, are produced by the combination machine.

Store Window Swings Open to Display Goods

AN ELECTRICAL store in Los Angeles has found a way to swing its show window wide open so that the display of house furnishing goods may be presented to window gazers more effectively.

This was accomplished by hingeing the huge plate-glass pane and its sash at one side and hanging the outer edge of the sash from a quadrant on the ceiling. During all but inclement weather the sash can be unlocked and pushed around on its track flat against the side wall.



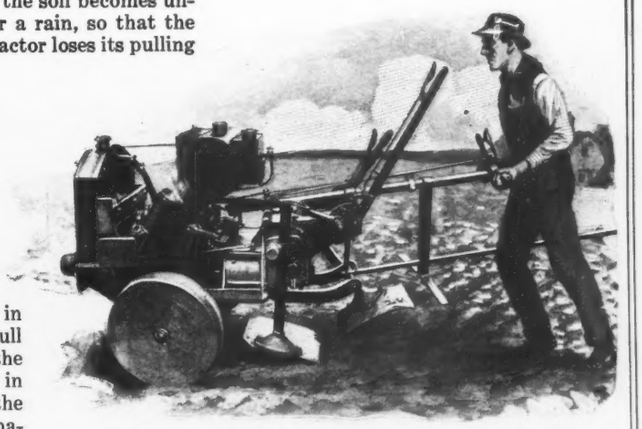
Cyclomobile Is Midget Auto, All but the Engine

A NOVEL "cyclomobile," designed and built by E. D. Prince, of Wilmington, Del., is propelled by pedals, but in other respects it is a tiny automobile with regular steering wheel, windshield and lamps.

The driving mechanism was taken from an old bicycle. The body was constructed of galvanized iron, No. 24 gage, and is nine feet three inches long by 31 inches high. Regular bicycle wheels were used, but to obtain better spring suspension the rear axle works through auto ball-bearing housings mounted in square blocks of cast iron. These are bolted endwise to the ends of two single sheave auto springs attached to the frame by a knee plate 21 inches forward of the rear axle. The result is a semi-cantilever spring suspension.

Mechanical Ox Walks over Ground

FOR farms where the soil becomes unusually soft after a rain, so that the ordinary wheeled tractor loses its pulling force, a mechanical motor-driven ox, or walking tractor, has just been invented. It is equipped with wheels so that it may easily be pushed along a road like a wheelbarrow; but in actual service a pull on a lever brings the curved steel "feet" in contact with the ground, and the machine walks ahead, step by step, pulling the plow behind it.



Revolving cranks in this strange walking tractor, lift the legs and feet, move them forward and then push them down

The top of each stiff steel leg is attached to a rocking pivot, so that the steel bar swings from a moving support as a leg does from the hip. The power is derived from a gasoline motor through a short crank, corresponding to the knee, to which the leg is pivoted about one quarter of the distance from the top. A similar crank pointing in the other direction is attached to the opposite leg.

As the cranks revolve, the legs and feet are lifted, moved forward, dropped to the earth, and then pushed back and down with great force, owing to the short leverage of the crank.

An ingenious system of gears solves the problem of walking machinery. If both legs were attached to the same axle, an instant would come when both feet would be off the ground—an instant that corresponds to the "dead center" in rotary machines.

To avoid this, the cranks work on an elliptical gear, so that the rate of revolution is speeded up as the foot leaves the ground. It moves forward very quickly, like the foot of an animal, and pushes to the rear slowly. Hence the tractive effort is constant.

The motor is of eight brake horsepower. The controls are within convenient reach of the man guiding the tractor. The construction of the machine makes it possible to turn it at the end of the field without leaving the furrow. Aside from guiding, the walking tractor requires little attention from the driver.

Faulty Vision the Rule

EXAMINATION of 10,000 employees in factories found 53 per cent with uncorrected, faulty vision. Of 675 employees in a typewriter company 58 per cent were found to be in need of glasses. Among 3000 employees in a paper-box factory the percentage of normal was only 28.

Tiny Flask Boiler Will Clean Pipe Quickly

NICOTINE and tobacco residue can be quickly removed from a pipe stem by means of a tiny steam generator consisting of a glass bulb connected with the pipe stem by rubber tubing. Steam generated by placing water in the bulb and holding it over a candle flame cleans the pipe chamber.

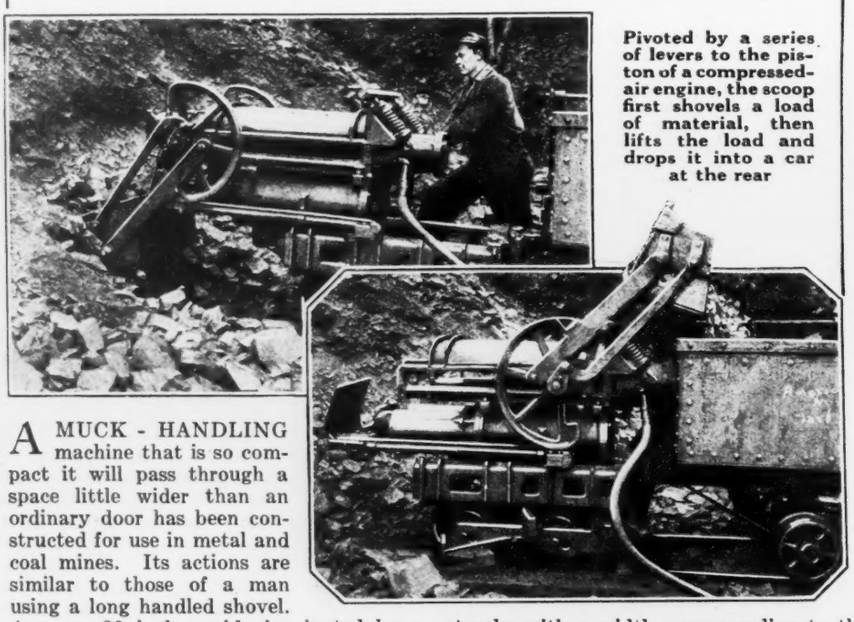
The steam pipe cleaner in action

Practice Tube Measures Singer's Lung Power

A NEW practice instrument to aid singers and speakers in developing breath control and lung power has been invented by J. Burlington Rigg, of Oak Park, Illinois. The apparatus consists of a cylindrical, transparent tube with its upper end open. This tube, which is graduated, and mounted on a standard, is provided with an inlet near its lower end for the breath.

Within the transparent cylinder is mounted an opaque cylinder, which is raised against gravity by the pressure of the breath acting on its lower end. The user of the device can see at a glance how much lung power he possesses and determine accurately how long he can sustain his breath with a given degree of power.

Machine Wields Shovel like a Man



Pivoted by a series of levers to the piston of a compressed-air engine, the scoop first shovels a load of material, then lifts the load and drops it into a car at the rear

A MUCK - HANDLING machine that is so compact it will pass through a space little wider than an ordinary door has been constructed for use in metal and coal mines. Its actions are similar to those of a man using a long handled shovel. A scoop 30 inches wide is pivoted by a series of levers to the piston of a compressed-air engine. As the piston is drawn into its cylinder, the scoop is brought into position at the base of the pile. Air is then let into the cylinder, thrusting the shovel forward and up.

After the scoop is filled with the muck or broken material, a further movement of the air piston swings the hopper upward over the air engine and to the rear, where the load is dropped into a car. This portion of the action is similar to that of a workman throwing a shovelful of dirt over his shoulder. The machine is on a set of trucks with a width corresponding to the track gage. The base of the working parts is mounted on a swivel to permit digging on any side.

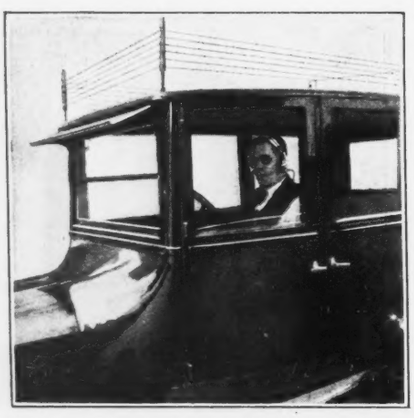
As fast as the machine advances into a pile of material new tracks are laid for it to run on.

In one test made in a metal mine, this loading device with four men as helpers advanced into a mammoth pile of broken material at the rate of one foot in 28 minutes. The best that six men could do without the loader was one foot in 70 minutes, proving the machine to be three times faster, with a saving of 30 per cent in labor.

Telephone Meter Tells How Long You Talk

TELEPHONE calls in Everett, Wash., are metered just like gas or electricity and the bills of subscribers are reckoned according to the time consumed by their conversation. The telephone meter was invented by Major Garrison Babcock, of Seattle, formerly of the United States Signal Corps, and has been adopted by the Puget Sound Telephone Company.

When the conversation begins, the mechanism of the meter is automatically set in motion and registers every interval of 15 seconds as long as the conversation continues. The exact time can be read on the three dials of the instrument, which is enclosed in a metal case and resembles the watt-hour meters in use on electric light circuits. When the conversation is finished and the receiver hung up, the meter mechanism stops.



Fence Type Aerial for Autos Is Permanent

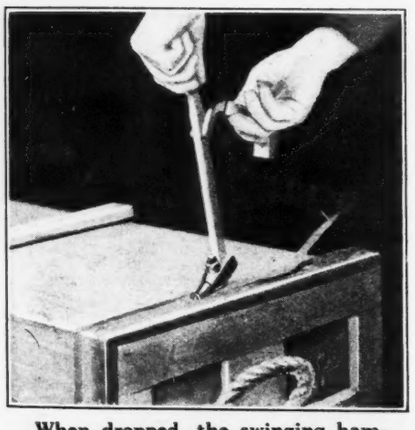
BY BUILDING an aerial in the form of a low six-strand fence around the top of an automobile and using the engine frame as the ground, a motor company of Detroit has widened the field of the portable wireless outfit by making it possible to receive messages without halting for earth connections. With a car equipped in this fashion it is feasible to drive 100 miles into the country and listen to broadcasting throughout the journey.

The aerial is formed by binding six strands of wire around insulated posts at the four corners of the car top, then connecting all the wires at one corner and leading them into the car through a weatherproof insulator over the driver's seat.

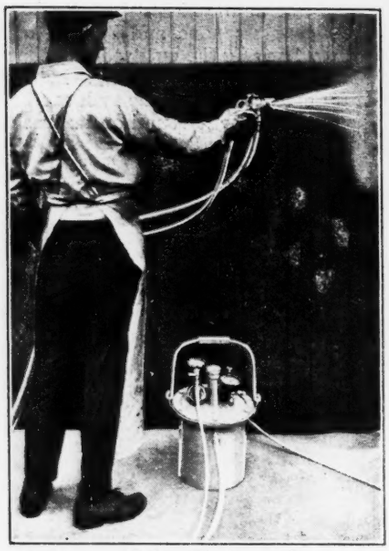
Staple Extractor Combines Lever and Hammer

AN INGENIOUS staple extractor that combines in one tool the functions of lever and hammer has been invented by David R. Schoonover, of Tuxedo Park, N. Y. The extracting head is mounted on the end of the lever arm and is removable for sharpening or for replacement. A short distance down on the lever a swinging hammer is attached.

The length of the hammer is such that when the head is lifted and dropped, it strikes the extractor on its flat head, driving the prong under the resisting staple, which can then be easily drawn.

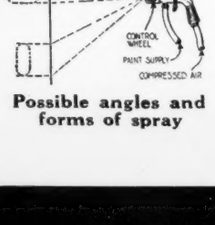


When dropped, the swinging hammer drives the extractor prong under a staple



Adjustable Paint Spray Gun Is Economical

A PAINT spray gun with which the operator can regulate the form of the spray, and the angle at which it leaves the nozzle has recently been devised to permit a painter to spray inaccessible corners without waste of paint. The new device has seven adjustments. A flat fan spray can be projected either vertically or horizontally, and its width can be varied from four to 30 inches. The narrow spray is used to paint I beams under eaves or in the apex of a roof. It can throw a cone-shaped spray 10 feet.



Possible angles and forms of spray

Are There Other Universes than Ours?

Astounding New Theory Pictures Ours as a Mere Pinwheel among Millions of Other World-Groups

Astronomy's Photographic Masterpiece—A Spiral Nebula

Are spiral nebulae such as this, photographed from the Mount Wilson Observatory, merely gaseous whirlpools close to the borders of our universe, or is each nebula a separate universe of solar systems as vast as the billion-starred system of suns in which we dwell? Many astronomers now believe that our universe is but one of countless "island universes," thousands of light-years apart

This remarkable edgewise view of a spiral nebula reveals the surrounding ring of dark matter. It is characteristic of nearly all spiral nebulae. Such an opaque ring, astronomers assume, borders our own universe. Note, too, the lens shaped form of the nebula. Photographs such as these require from 10 to 12 hours' exposure in cameras attached to the world's largest reflecting telescope

THOSE who love to moralize about the infinitesimal nothingness of man and his world in comparison with the vastness of the universe should be happy now. For out of the present controversy about the dimensions of our billion-starred universe has emerged the astounding probability that it is only one of at least 700,000 similar universes that can actually be photographed with modern high-powered reflecting telescopes.

A Revolutionary Theory

This theory of "island universes," as it is called, is in many ways the climax to the drama begun more than 5000 years ago when first the Chinese, the Egyptians, and the Babylonians attempted to find some connection between the phenomena of seasonal changes and the mysterious movements of sun, moon, and stars. It is in amazing contrast with the theory dominant from the times of Hipparchus and Ptolemy to about the sixteenth century, that the universe had the earth for its center, with sun, moon and stars as satellites. The theory of island universes makes the earth and our entire solar system an utterly insignificant speck in the heart of a comparatively insignificant star cluster.

Prominent in the controversy which has brought the island universe theory to the fore, are Dr. Harlow Shapley, newly appointed director of the Harvard College Observatory, and Dr. Heber Curtis, director of the Allegheny Observatory, Pittsburgh, Pa.

According to Dr. Harlow Shapley, the system of stars to which our sun belongs is far larger than it has hitherto been supposed to be. This system is often described as the *galactic universe*. It is called "galactic" because its form is now assumed to be more or less defined by the glowing zone known as the galaxy, or Milky Way. The term "universe" is a misnomer, since nobody supposes that this system includes the sum total of existing matter. Beyond its bounds, as generally defined, lie the spiral nebulae, of which hundreds of thousands have been observed and of which more will be said later in connection with the island universe theory. Moreover, there may be, and probably are, unthinkable multitudes of celestial objects more remote than any yet observed.

Our galactic system is a much flattened star system, containing, according to the most conservative estimate, upward of a thousand million stars, of which our sun is one. The flatness of its form is well expressed by comparing it with a grindstone or a rather thin watch, but we have no reason to assume that its outline is circular. A plausible guess assigns to it the complicated form of the spiral nebulae, which we shall presently describe. Our solar system lies somewhere near the middle

plane of the "grindstone," though probably not, as was once supposed, in a central position with respect to its circumference. Looking along this plane, we see the stars densely crowded in a belt that encircles the sky. This is the Milky Way. Looking away from the plane, our gaze encounters a much thinner layer of stars, which therefore appear sparsely distributed over the heavens.

If we compare the galactic system to a country and the stars to its inhabitants, we shall find that, like human beings, the citizens of this far-flung empire have a strongly gregarious tendency. Isolated existence is not popular among the stars. They tend to cluster in celestial towns and villages, so to speak. The sun inhabits one of these communities.

Although the stars in our local cluster are in rapid motion, they have plenty of elbow room, and the chances of a collision are extremely remote. The sun's nearest stellar neighbor, Alpha Centauri, is so far away that, if it were suddenly annihilated, its light would continue to shine in our skies for 4.3 years. In other words, its distance from the solar system is 4.3 light-years, a light-year being equivalent, in round numbers, to nearly 6,000,000,000,000 miles.

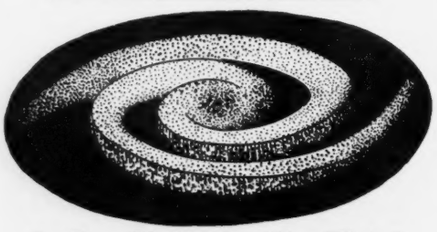
"Why do modern astronomers find such a measuring rod necessary?" it has frequently been asked.

Earthly Units Inadequate

On the surface of the earth, distances can be expressed in units such as inches, feet and miles. Even on the moon, astronomers can state the diameter of craters and width of valleys in miles. But such everyday units of measurement become hopelessly inadequate when the dimensions of a star are considered, as, for example, distances on the surface of our sun. It is practically impossible to measure sun spots in earthly distances, and indeed the diameter of the earth itself is none too large a unit.

Dr. Heber Curtis

Director of the Allegheny Observatory, Pittsburgh, Pa., whose researches support the "island universe" theory



Is Our Universe like This?

THE spiral nebula, as pictured in the above diagram, is usually seen to consist of a large lens-shaped central nucleus from which extend two curving arms which, as they wind outward in the same plane, become more fragmentary. The shaded portion represents the dark band usually seen on the outside of the spiral arms, supposed to be a ring of opaque matter.

Dr. Harlow Shapley holds that the spirals are masses of nebulous matter on the outskirts of our galactic system, the diameter of which he estimates at 300,000 light-years, with a thickness of about 30,000 light-years.

Holding the theory, on the other hand, that the spiral nebulae like our own galaxy are separate "island universes," Dr. Heber Curtis says that our universe is probably not more than 30,000 light-years in diameter, and not more than 5000 light-years in thickness.

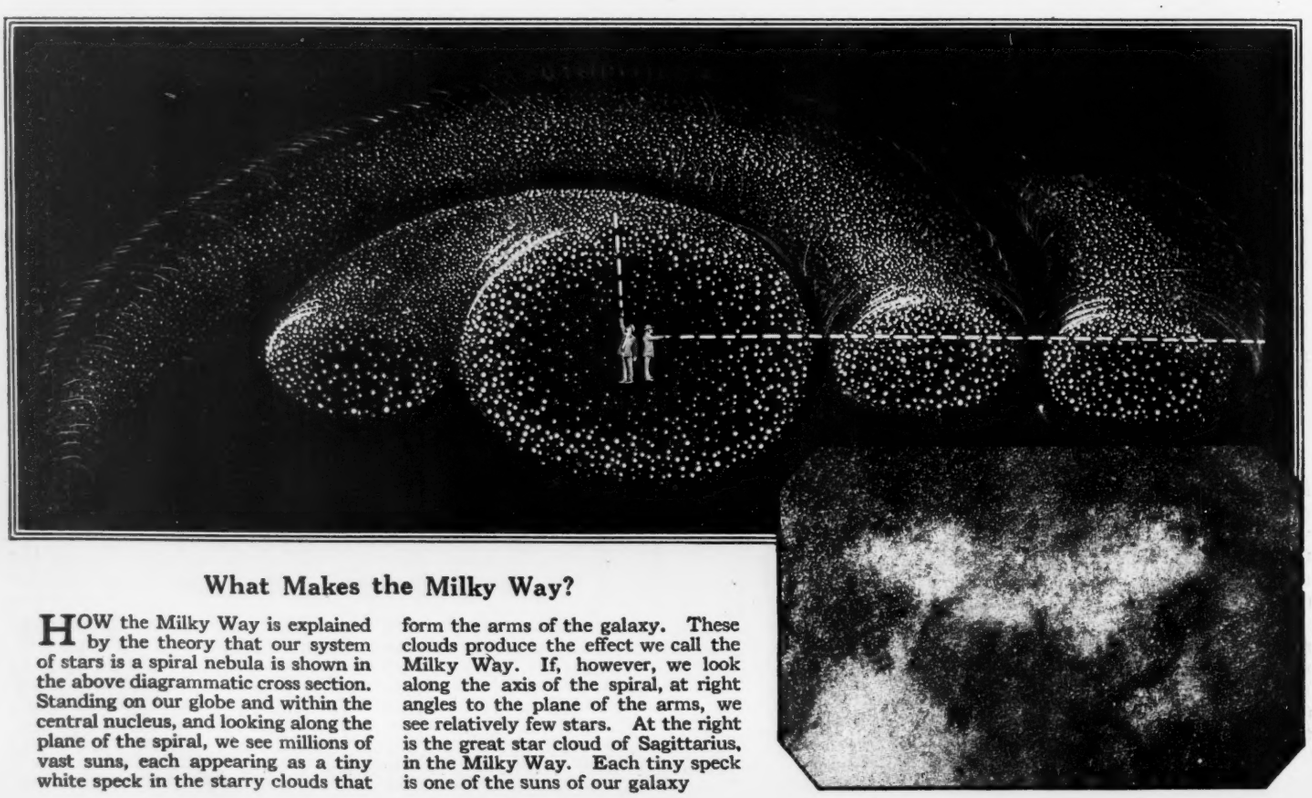
For measuring the distances from the sun to its planets, the so-called astronomical unit is employed, being the average distance from earth to sun, or 12,000 times the diameter of the earth. "This unit, 93,000,000 miles in length, is ample for the distances of planets and comets," according to Doctor Shapley. "It would probably suffice to measure the distances of whatever planets and comets there may be in the vicinity of other stars; but it, in turn, becomes cumbersome in expressing the distances from one star to another, for some of them are hundreds of millions, even a thousand million, astronomical units away."

As a consequence, the astronomical unit is not used for such measurements and instead, astronomers introduce the "light-year." It is the distance that light, with its velocity of 186,000 miles a second, travels in one year. It is equivalent, as stated above, to about 6,000,000,000,000 miles.

More distant parts of the galactic world have been explored, not only with the telescope, but also by means of celestial photography, which is far more powerful than telescopic vision. Besides hosts of star clusters, the camera reveals immense clouds of nebulous matter; some, as shown by the spectroscope, consisting of gas, and others of cosmic dust, lighted up by stars in their midst. One of the most striking recent disclosures of astronomical photography, is the fact that many of these nebulae are dark, or only faintly luminous, and are therefore seen as opaque black masses.

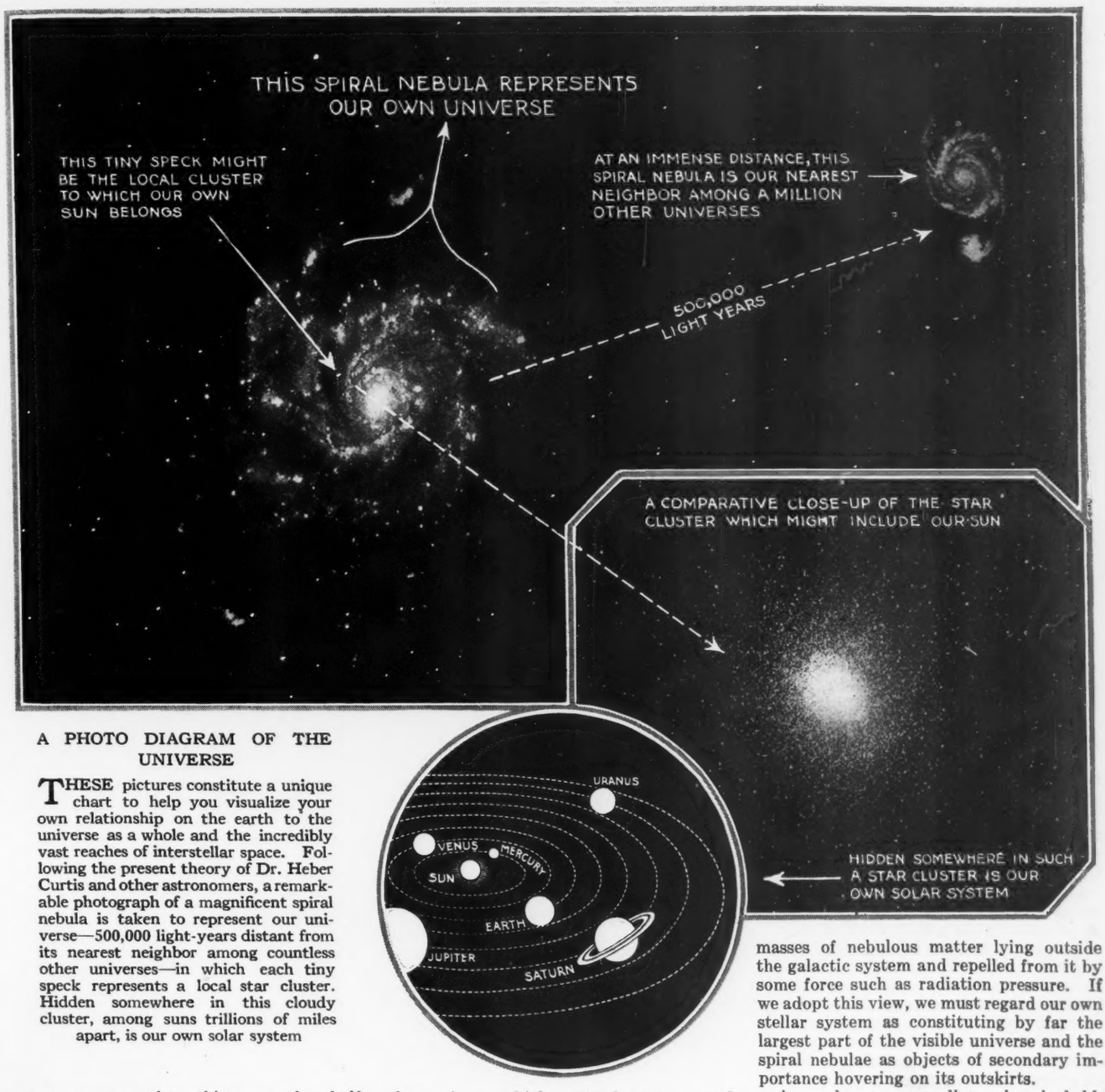
The Congregations of Stars

Toward the outer limits of the galactic system, Shapley places certain dense aggregations of stars known as globular clusters, of which about a hundred have been enumerated. He finds that one third of these are more than 100,000 light-years away from us, while the most remote of all—"N. G. C. 7006"—is at a distance of 220,000 light-



What Makes the Milky Way?

HOW the Milky Way is explained by the theory that our system of stars is a spiral nebula is shown in the above diagrammatic cross section. Standing on our globe and within the central nucleus, and looking along the plane of the spiral, we see millions of vast suns, each appearing as a tiny white speck in the starry clouds that form the arms of the galaxy. These clouds produce the effect we call the Milky Way. If, however, we look along the axis of the spiral, at right angles to the plane of the arms, we see relatively few stars. At the right is the great star cloud of Sagittarius, in the Milky Way. Each tiny speck is one of the suns of our galaxy


THIS SPIRAL NEBULA REPRESENTS
OUR OWN UNIVERSE
THIS TINY SPECK MIGHT BE THE LOCAL CLUSTER TO WHICH OUR OWN SUN BELONGS
AT AN IMMENSE DISTANCE, THIS SPIRAL NEBULA IS OUR NEAREST NEIGHBOR AMONG A MILLION OTHER UNIVERSES
500,000 LIGHT YEARS
A COMPARATIVE CLOSE-UP OF THE STAR CLUSTER WHICH MIGHT INCLUDE OUR SUN
URANUS
VENUS
MERCURY
SUN
EARTH
JUPITER
SATURN
HIDDEN SOMEWHERE IN SUCH A STAR CLUSTER IS OUR OWN SOLAR SYSTEM

A PHOTO DIAGRAM OF THE UNIVERSE

THESE pictures constitute a unique chart to help you visualize your own relationship on the earth to the universe as a whole and the incredibly vast reaches of interstellar space. Following the present theory of Dr. Heber Curtis and other astronomers, a remarkable photograph of a magnificent spiral nebula is taken to represent our universe—500,000 light-years distant from its nearest neighbor among countless other universes—in which each tiny speck represents a local star cluster. Hidden somewhere in this cloudy cluster, among suns trillions of miles apart, is our own solar system

years, or more than thirteen and a half thousand million times the distance of the earth from the sun!

As these clusters undoubtedly belong to the galactic system, the latter is supposed to have a diameter of something like 300,000 light-years. Shapley supposes that the globular clusters are being drawn into this system from outer space and that they gradually break up into looser aggregates under the gravitational pull of the surrounding stars. This would explain why they occur only at the edge of the galaxy.

Galaxy Is Smaller, Says Curtis

Doctor Curtis, adhering to an older view regarding the size of the galactic system, believes that it is not more than 30,000 light-years in diameter and perhaps 5000 light-years in thickness. To the globular clusters he assigns an average distance from our earth of about 10,000 light-years.

We have now come to the leading bone of contention among contemporary astronomers—the spiral nebulae. In appearance, a spiral nebula is a sort of celestial pinwheel. Viewed sidewise, it is generally seen to consist of a large central nucleus, from which extend two curved arms. These objects are, however, very much flattened, so that an edgewise view takes the shape of a narrow spindle. Running through the middle of the spindle, in the direction of its length, is a dark band, supposed to be a ring of opaque matter bordering the nebula.

A few spiral nebulae have been known for generations, but their great abundance in the heavens was entirely unsuspected until the late Professor Keeler began to photograph them at the Lick Observatory about the year 1900. According to recent estimates, at least 700,000 and possibly a million or more are accessible to celestial photography.

One of the strangest things about the spirals is their distribution over the sky. None is found in the Milky Way, and few near it. Lastly, the few spirals whose motions have been determined with the spectroscope are found to be traveling at an amazing speed with respect to our system—in one case, as fast as 1100 miles a second—and most of them are receding from us. Their spectra seem to show that they are, at least in part, solid or liquid.

According to Shapley, the spirals are masses of nebulous matter lying outside the galactic system and repelled from it by some force such as radiation pressure. If we adopt this view, we must regard our own stellar system as constituting by far the largest part of the visible universe and the spiral nebulae as objects of secondary importance hovering on its outskirts.

A much more grandiose view is held, however, by many astronomers, of whom Curtis has recently been the leading spokesman. As we have seen, Curtis assigns more modest dimensions to the galaxy than does Shapley, but for his conservatism in this respect he makes ample amends by his speculations that the spiral nebulae are not gaseous objects "of secondary importance" but rather aggregations of stars, in all important aspects like our own universe.

A Mere Drop in the Bucket

That the mighty system of stars to which our sun belongs is a mere drop in the celestial bucket was a common belief among astronomers during the first half of the nineteenth century, the theory having first been formulated by the great Sir William Herschel. It was then supposed that there was no difference between nebulae and star clusters except that the former were too far away to be resolved into stars by the biggest telescopes. Humboldt described these supposedly remote nebulae as "island universes." Later, the spectroscope proved that many nebulae are clouds of gas and clusters of stars, and hence their telescopic

appearance is not necessarily an indication of great distance.

Thus the theory of island universes fell into discredit, but thanks to modern study of spiral nebulae, the theory is now enjoying a new lease of life. According to Curtis and others, the spirals are immensely distant systems of stars, as big, on an average, as our billion-starred system.

An Invisible Screen

Curtis has likewise suggested an explanation of the fact that no spiral nebulae are seen near the Milky Way. They are, he thinks, as common in that direction as any other, but are screened from our sight by a ring of dark matter bordering our system, similar to that which, as we have already mentioned, borders many spiral nebulae.

For, as was suggested, many astronomers now maintain that our own billion-starred universe is itself a spiral nebula. The ring of dark matter assumed to surround our universe, points toward this conclusion because a similar ring is found in most spiral nebulae observed—for example, the nebula pictured in edgewise view on page 37. Another indication is the familiar Milky Way, which is easily explained as a result of perspective if we consider it as the equator of our lens-like star system.

Many spiral nebulae register as tiny specks of light on photographs taken, with an exposure of many hours, by cameras attached to the most powerful telescope in the world. If the theory is correct that assumes them to be vast "universes," thousands of light-years in diameter, it is evident that they must be almost inconceivably far away. Curtis has estimated, in fact, that while a few spirals, such as the Great Nebula in Andromeda, which is visible to the naked eye, may be as near as 500,000 light-years, the most remote of these objects, known only through telescopic photographs, are at a distance of *a hundred million light-years*. It would serve no useful purpose to turn this figure into miles; but it may be of interest to note, by way of comparison, that the distance of the sun from the earth, 93,000,000 miles, is equivalent to only eight light-*minutes*, while the distance from the earth to the moon is only 1.3 light-*seconds*.

Marvels of Photography

Lastly, consider what it means to photograph an object a hundred million light-years away from the earth. Before registering itself upon the photographic plate, the light utilized in this process has not only performed an enormous journey in space—retaining its identity and its power to record a faithful image of the thing from which it came—but it has also performed an enormous journey in *time*. We do not photograph the object as it is today, but *as it was a hundred million years ago*.

Reciprocally, suppose that a spiral nebula is situated at this distance and that on one of its worlds there are astronomers who have developed such powerful telescopes that they are able to photograph our solar system in some detail. What sort of *earth* do the pictures they are now taking reveal? Perhaps none at all—since it is not absolutely certain that our planet existed a hundred million years ago. But in any case, a very different earth from the one we know. A primeval globe, upon which, if a "close-up" could be taken from this stupendously distant point of observation (and of course we don't wish to suggest seriously that it could), the picture would probably disclose no trace of life—certainly no trace of human life.

"Dark Nebulae"—a Stellar Mystery

THE long black lanes in this Yerkes Observatory photograph—apparently vacancies among the stars—are, in reality, masses of opaque matter, silhouetted against the starry background. These "dark nebulae," when photographed with a powerful reflecting telescope, appear to be physically connected with the masses of bright nebulous matter seen in the picture

The Two Theories

In conclusion, the controversy between Curtis and Shapley over the nature of spiral nebulae and the dimensions of our galaxy may be summarized as follows (Bulletin of the National Research Council, Number 11):

Curtis: Our galaxy is probably not more than 30,000 light years in diameter, and perhaps 5000 light-years in thickness.

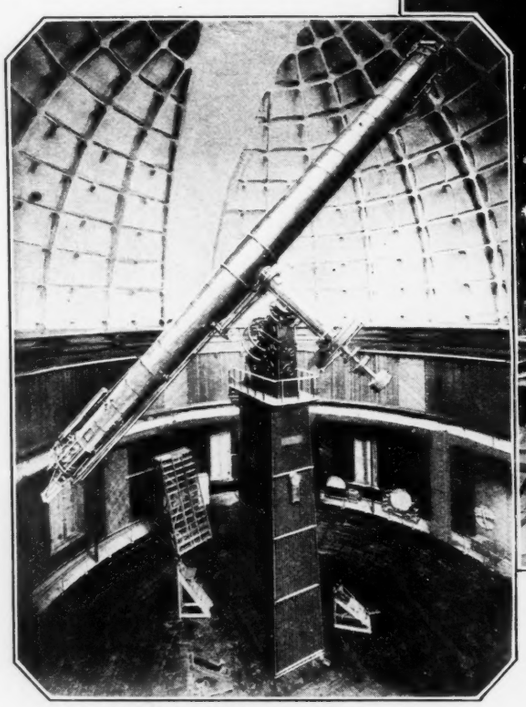
Shapley: The galaxy is approximately 300,000 light years in diameter, and 30,000, or more, light-years in thickness.

Curtis: The clusters, and all other types of celestial objects except the spirals, are component parts of our own galactic system.

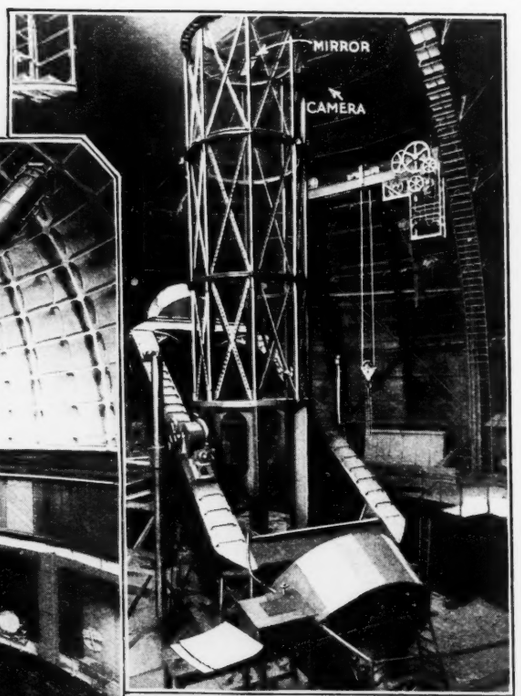
Shapley: The globular clusters are remote objects, but a part of our own galaxy. The most distant cluster is placed at about 220,000 light-years away.

Curtis: The spirals are a class apart, and not intra-galactic objects. As island universes, of the same order of size as our galaxy, they are distant from us 500,000 to 10,000,000, or more, light-years.

Shapley: The spirals are probably of nebulous constitution, and possibly not members of our own galaxy, driven away from the regions of greatest star density.



This refracting telescope, in which the image of a heavenly body is refracted through a lens to the eyepiece, is one of two types of instruments in use at the Lick Observatory, Mount Hamilton, Calif., for study of celestial bodies



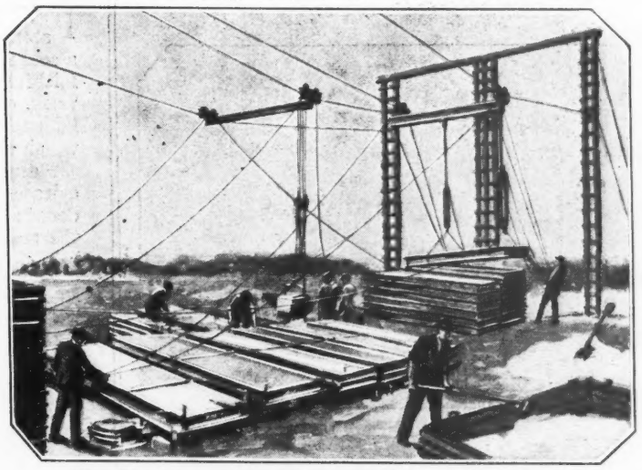
The remarkable photographs of spiral nebulae and star clusters reproduced on these pages, were obtained by powerful reflecting telescopes such as the Mount Wilson Observatory instrument shown above. Here, images of celestial bodies are reflected from a large mirror to a smaller mirror and thence to the photographic plate. Driving clocks move the telescopes to follow the apparent movement of the stars, due to the earth's rotation

Cableway Builds Houses of Concrete Slabs

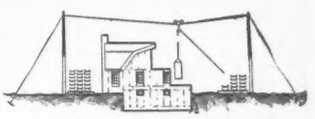
BUILT of blocks piled one upon another, like toy houses in a nursery, artistic concrete homes have recently been completed near Reading, Pa., by an ingenious method that bids fair to answer the problem of cheaply supplying American families with attractive dwellings.

With an estimated shortage of half a million houses throughout the country, builders have been searching for some system of house construction that will allow rapid fabrication at low cost and at the same time produce structures measuring up to the standard of architecture in the average community. The chief disadvantage of several proposed methods of erecting concrete houses by the use of portable forms into which the fluid concrete is poured has been a sameness in architecture.

How the cableway is used in cellar excavation



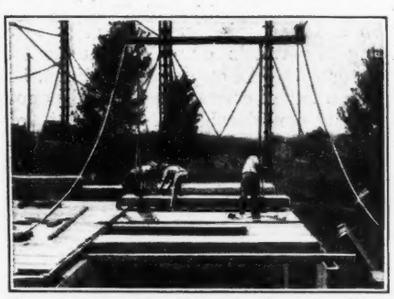
The first step—concrete is carried in buckets on the aerial railway and poured into molds. After the concrete sets, the slabs are stacked at either side



Erecting the house with pre-cast concrete units

The new system tried out at Reading, departs from these methods by employing pre-cast concrete slabs that can be built up from the ground to any height and in any shape.

For the first time in the history of house construction, a unique aerial railway, slung from inexpensive portable supports at opposite sides of the building site, is used at Reading to handle the heavy concrete slabs. On these cableways are mounted traveling carriages moving transversely and equipped with chain blocks. Three building operations are performed by the cableways — the casting and stacking of the concrete slabs, excavation for the foundation, and the erection of the building itself.



Traveling carriages, equipped with chain blocks, lay the concrete units of the floor as shown above

In making ready for a pre-cast house by the new method, the forms of finished wood, or a combination of wood and steel, are hauled to the center of the lot and assembled. Concrete is mixed, carried by cableway to the molds, and poured. After the concrete has set, the slabs are picked up by the cranes and carried to each side of the site, where they are stacked for three days while the curing process goes on. At frequent intervals during this time the slabs are sprayed with water to keep the outer surfaces moist. During the curing process the cableway, equipped with digging bucket, speedily excavates the cellar.

When all the slabs are completed, the forms are removed and the aerial railway is hooked to an excavating shovel, which carries the loose dirt to a dump outside the building area. The cableway then handles the slabs, from the stacks to their positions in walls or floors, swinging them into place with a minimum of labor. The foundation units are first carefully leveled. These blocks contain holes into which fit dowels of the wall blocks, thus fixing exactly the position of wall units into which the floor slabs are also doweled.

Floor slabs come from the forms sufficiently smooth to finish without plaster. The units, when placed side by side, form a beamed ceiling. Note dowel pins and air spaces

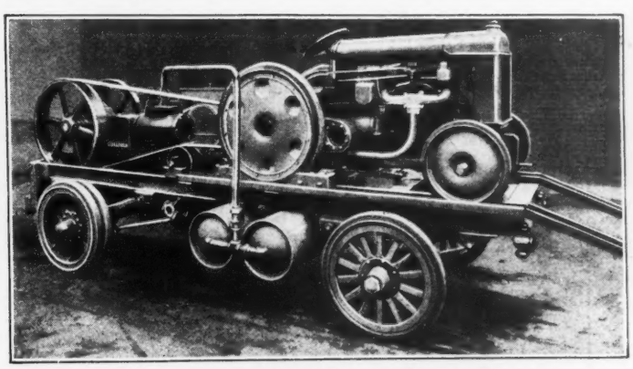
By taking extreme care in constructing the portable molds, it is possible to produce slabs with such smooth surfaces that they can be left untreated or covered with plaster or stucco at the owner's wish. Floor slabs are cast with one side ribbed to give a beamed ceiling effect to the rooms below.

The method used in joining the wall slabs leaves a dead-air insulating space between them that has been found effective in normalizing the inside temperature.

Full equipment with which to cast a two-story, six-room house, with bath, 14 by 43 feet, consists of 60 forms costing about $6000. But as each set of forms can be employed on at least 100 jobs, the cost of each form is reduced to the low figure of one dollar. Mr. William Painter, inventor of the method, has estimated that with a crew of experienced workmen a six room house can be erected in nine days.

Tractor Hauls Compressor to Job and Runs It

FACED with the problem of supplying air compression machinery in quick time and at a minimum cost, a firm in St. Louis, specializing in demolishing concrete walls and buildings, finally hit upon the idea of a combination truck body, tractor, and compressor.



The outfit consists of an air compressor mounted on a built-up truck body and a small farm-type tractor. When a call comes for the outfit, the tractor is hooked to the truck and drags it to the job. There the tractor climbs to the truck body on portable skids. After it is blocked solidly, the flywheel is belted to the air compressor.

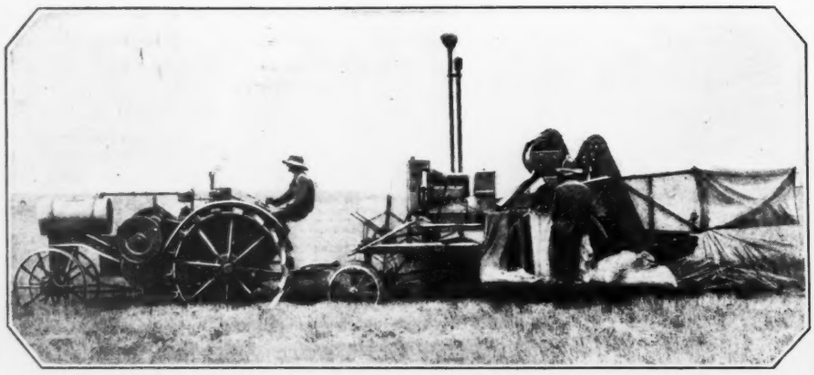
With this combination one power plant does the work of two at a saving in maintenance and upkeep.

Carbon Dioxid Bombs Put Out Coal Fire

CARBON dioxid bombs are being used successfully to extinguish fires in the interior of huge piles of coal in storage. Wherever a fire is feared, steel bombs filled with liquid carbon dioxid and equipped with fusible plugs are inserted in various parts of the pile. If the temperature of the pile rises to the point where ignition is likely to take place, the plug melts and the carbon dioxid escapes, cooling the coal and extinguishing the fire, should there be one.

Another method is to drive long pipes into the coal where smoke is thickest and pour carbon tetrachlorid through them. This liquid forms a vapor, five times heavier than air, which sinks downward and deprives the fire of the oxygen necessary to maintain combustion.

Single Machine Cuts and Threshes Grain



THE demand of farmers for a combined harvester-thresher has been met by one of the leading implement manufacturers with a machine that cuts the standing grain and elevates it to a motor driven cylinder near the front of the machine, where it is threshed. The grain runs into sacks on a platform at the side of the machine. A man riding on this platform ties the sacks as they are filled and throws them in piles along the route. Later they are picked up and hauled by trucks to storage or to market.

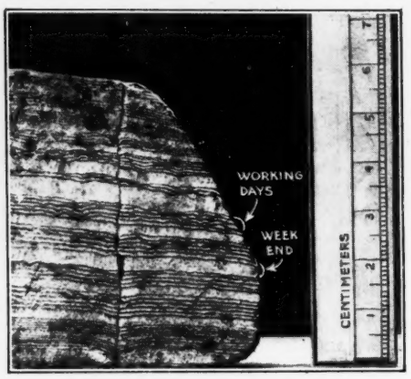
The straw from the threshed grain is thrown to the rear of the machine as it progresses, so that it may be plowed under to enhance the fertility of the soil.

The combination machine is drawn by a 10 to 20 horsepower farm tractor and two men can operate the whole outfit. When the ground and other conditions permit, a wagon is attached to the side of the machine and the threshed grain is elevated directly into it, thus saving the cost of sacks and the labor of handling them.

Striped Stone Forms Diary of Miners' Work

IN THE British Museum has been placed a stone taken from the watering trough of a coal mine in South Shields, which bears a faithful record, day by day and week after week, of the days during which the miners labored and the nights and holidays during which they rested.

Narrow white streaks formed by white, calcareous mud deposited from the water denote the nights. During the daytime the coal dust mingled with this mud, the blackened deposits thus representing the working days. Week ends and holidays are marked by wider white streaks.



Successive layers of white and black mud form a record of miners' work

Radium Attacks Cancer in Plant Experiments

CANCER specialists, including Dr. Isaac Levine, of the Montefiore Hospital, New York City, have undertaken a series of experiments with plants in the hope of finding the possible cause and cure of the dread disease that has baffled physicians for years. They are studying the effect of cancerous growths upon normal plants, first inoculating the plants and later treating them with radium tubes inserted into the growth.

Results so far obtained show a definite breaking down of the plant form of cancer under the emanations from radium. Further study, it is hoped, will reveal the most effective way of carrying on the treatments.

Although the high voltage X-ray machines that have come into general use during the past year will continue to be an important means of reaching deep seated cancerous growths, there are, of course, many cases in which the radium tubes can be inserted directly into the tumor without damaging the adjacent tissue.

Endless Treads Pull Glass Into Tubing

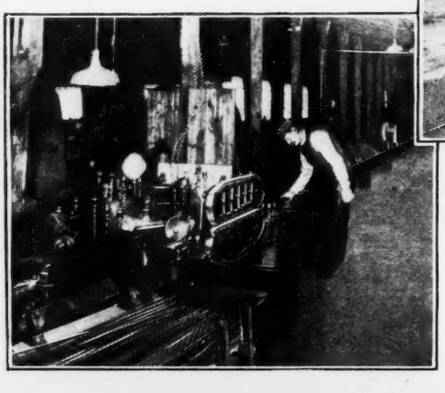
MACHINES that pull perfect tubing from furnaces of molten glass are a recent development of the glassmaking industry that may make "blowing" a thing of the past.

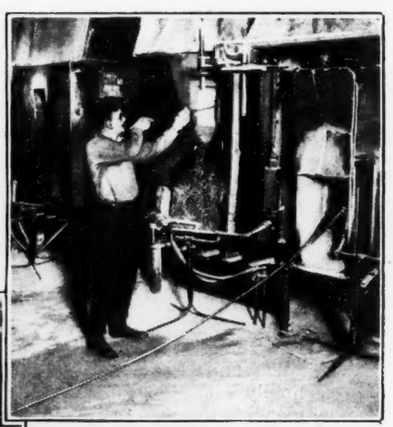
While following closely the general methods of hand operation, the machine makes possible continuous production by means of a rotary blowpipe and mechanisms that exerts a constant pull on a piece of glass tubing.

Hand operation in making a tube requires two men. One man holds a large mass of molten glass on the end of a blowpipe. While he blows, a second man sticks a metal instrument, called a "punty," into the glass and backs away down a long walk, drawing the tube after him until all the glass on the end of the blowpipe is exhausted. By the mechanical method, the blowpipe is mounted inside a reheating furnace in an inclined and elevated position. While the pipe turns on its axis at a fairly high rate of speed, a supply of molten glass pours slowly over it, so that there is always a mass of glass on the tip of the pipe. The glass flows off the end of the pipe by gravity and by the pull of the machine.

The glass cools as it drops from the tip of the blowpipe, and forms a long straight tube supported by a line of idler wheels, which extends about 125 feet to an ingenious power-driven pulling machine. Here two endless chains carrying grips resembling the treads on a continuous tread tractor rotate in opposite directions, holding the tube between them firmly enough to exert considerable pull, but not firmly enough to break it.

Once the temperature of the glass has been properly adjusted, the production of any given size of tubing is practically automatic.





Drawn from the tip of a blowpipe mounted inside the reheating furnace shown above, the glass is pulled out into a tube by a power machine (at left), consisting of two endless treads that grip the tube between them. The tubing is supported on idler wheels

Street Corner Crashes Fill Auto Graveyards

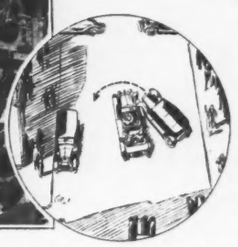
Fifteen per cent of crashes with street cars are caused by attempts to beat cars across intersections

AN ACRE OF WRECKED CARS

Of the 600,000 motor accidents that yearly produce twisted piles of wreckage such as this, only one in every 500 can be classified as "unavoidable"

Attempts to turn corners too quickly on wet pavements cause 40 per cent of skidding accidents

One fourth of all auto mishaps occur at street intersections where drivers abuse right of way rules or fail to signal



Turning in the middle of the block is the most common cause of accidents that occur between street intersections

EVERY 25 seconds last year, carelessness caused an automobile accident involving personal injury. Nearly 12,000 persons were killed, and 1,500,000 injured.

Every large city has its "graveyard" where wrecked cars too badly damaged to be worth salvage are piled by the acre. And among the thousands of accidents represented by these tragic junk heaps, less than one fifth of one per cent—one in every 500—can be classified as unavoidable.

Inattention of drivers is the chief cause of automobile disasters, and the greatest danger points are street or road intersections where 25 per cent of all accidents occur according to statistics compiled recently by the Automobile Club of Southern California from a tabulation of 1000 accident reports. These reports reveal that of the wrecks at street intersections, 40 per cent are caused by overturning, 28 per cent by failure to give an "arm signal," 24 per cent by abuse of "right of way," and eight per cent by cutting corners.

Between street intersections or in open country driving occur 19 per cent of the accident total. Most of these are caused by turning in the middle of the block.

Other causes, classified in the order of their importance, are:

Cars struck while parked, 10 per cent.
Faulty brakes, nine per cent.
Skidding, six per cent.
Mishaps on curves, four per cent.
Collisions with street cars, two per cent.
Glaring headlights, one per cent.

Electric Spark to Light Aviator's Cigarette

A SAFE cigarette lighter and holder for airplane use has recently been invented. The novelty of the holder is embodied in the electric spark that lights the cigarette. The spark gap inside the holder is connected with the magneto of the plane motor by a light flexible cord.

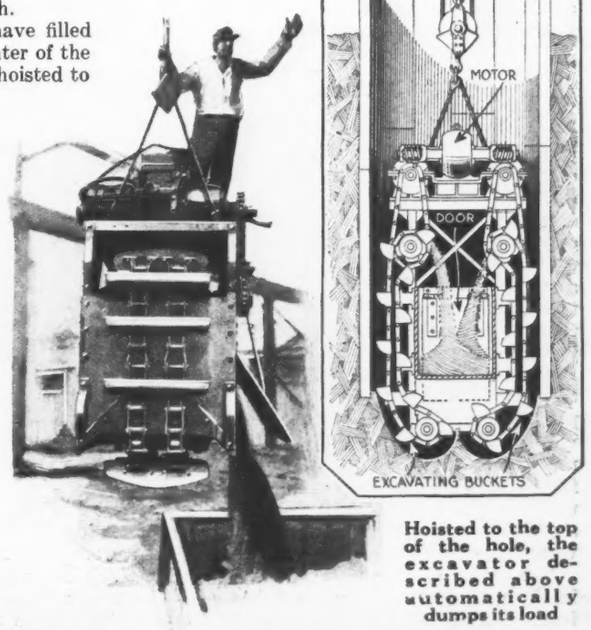
An insulated holder totally incloses the burning tip and prevents sparks from flying.

Endless Chain Excavator Dumps Its Own Load

EXCAVATING with a conveyor belt is now proving practical with an ingenious machine consisting of an endless chain carrying grab buckets that are forced into the ground by gravity as the machine descends, removing the earth.

As soon as the buckets have filled an earth container in the center of the machine, the whole outfit is hoisted to the top of the excavation, where the dirt is automatically dumped from the side into trucks.

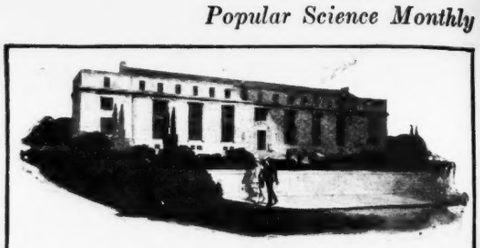
An electric motor drives the two independent systems of buckets by a worm gear connected with the conveyor by a link chain. The buckets, wide and shallow, almost meet at the center of the excavation. Earth is scraped from the center to the edges of the hole, then carried up the sides and dumped into the container as the buckets pass over the driving wheel for the return trip. The entire machine may be rotated so that the buckets can dig on all sides.



Hoisted to the top of the hole, the excavator described above automatically dumps its load

San Diego Opens Nature's Treasures to the Public

REALIZING that natural science is too vital a subject to be locked up in the rooms of a building, San Diego, Calif., has carried its museum to an entire community, opening the vast treasure chest of nature to all. Enthusiastic "nature hikes" are taken by San Diego grown-ups and children under a lecturer's guidance. The following article on this novel municipal enterprise may awaken other cities to the possibility of making science an increasingly popular adjunct to civic spirit.



A Shrine of Science

THIS $1,300,000 home of the National Academy of Science and National Research Council will be built soon at Washington, D. C. A large lecture room on the main floor will be surrounded by seven exhibition rooms, in which the newest scientific discoveries will be illustrated and interpreted for the public

A NATURAL history museum that is almost the equivalent of a free University course always open to the public, offering to an entire community entertaining instruction in scientific subjects, is becoming one of the most popular of all civic enterprises in San Diego, Calif. There the term "museum" no longer means merely a storehouse of prehistoric skeletons and dusty stuffed animals, but a depository of interesting things that directly affect every-day life.

On the assumption that comparatively few people will go to a museum to inspect the newly unearthed skeleton of a dinosaur, while almost the entire population will turn out to examine the carcass of a mountain lion killed by high school boys, directors of the museum have substituted, instead of a series of lectures, a series of "nature walks."

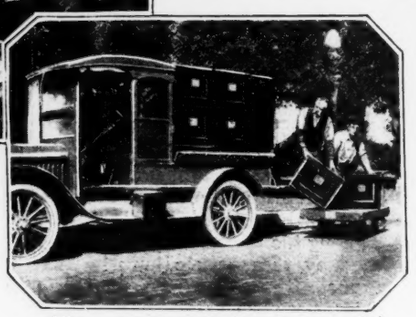
One of the "nature walks" conducted by the San Diego, Calif., National History Museum. A geologist is explaining the formation of the country to an interested audience

Recently a lecturer for the museum met his audience on a California sea beach. To the audience every object in sight was familiar; yet when the lecturer began to talk about the shells and pebbles along the seashore and to tell of the life and habits of the shore birds, the commonest objects assumed a new and fascinating meaning. Many of the audience collected shells named and described by the lecturer. Others took notes for future reference and study.

Soon after the first "nature walk" booksellers in the city reported a marked increase in the sale of popular books on geology, birds, botany, and kindred subjects, demonstrating that the museum had succeeded in awakening scores of persons to the marvels of nature all about them.

On another walk, the museum geologist accompanied his audience to the highest point near the city and from there explained the geological history of the surrounding country. This trip ended at a fossil bed, where each person gathered interesting specimens. Other walks led to forests where birds, plants, and insects were studied.

Not content with capturing the interest of the man on the street, the museum invaded the city schools, in the form of 50 cabinets, each containing in five drawers 35 specimens of stones, shells, birds, animals, and plants. With each cabinet went literature prepared by the muesum staff, supplementing the nature study course prescribed by the school authorities. A cabinet remains for five weeks in each school.



The museum invades the schools with cabinets, each containing 35 specimens of animals, birds, plants, and stones

Mirror at Blind Crossing Warns Motorists

FAMILIES living near a "blind crossing" at Rochester, N. Y., have erected at their own expense a mirror that gives motorists a view down the track, thus warning them of approaching trains in time.

The contour of the ground at that point prevents a view of the track until the motorist's front wheels are actually on the rails. The mirror provides sufficient time for the application of brakes when danger threatens.

The need for better protection is reflected in the 1921 death toll from railroad crossings. During last year, according to a report from the Interstate Commerce Commission, 1500 autoists were killed and 4500 seriously injured in crashes at road and track intersections. A large proportion of these accidents were due to inability of drivers to see the tracks in both directions.

Animal Gland Industry Becomes Important

MANUFACTURE of medicinal and surgical products from the various glands of domestic animals slaughtered in the big packing houses is becoming an increasingly important and diversified industry in the United States.

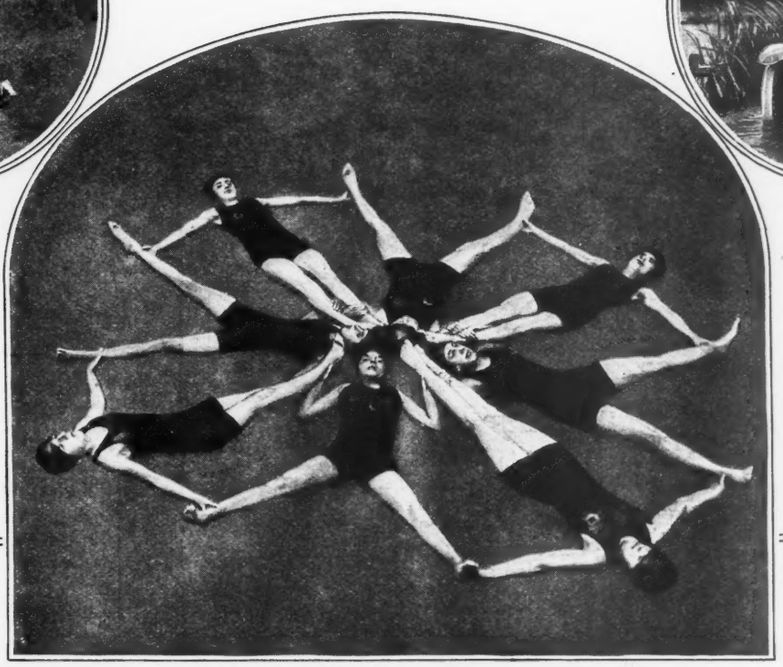
The first substances of this nature produced in commercial quantities were rennet and pepsin, according to the United States Bureau of Chemistry. Later came the manufacture of pancreatin from pancreatic glands and extracts of the thyroid glands.

Glands and tissue are obtained from cattle, calves, sheep, and hogs, and are sold by the packers to pharmaceutical houses. One concern, it is reported, now puts out 35 preparations for medicinal and surgical use extracted from these glands and tissues.

Camera Brings Strange News from Far Corners

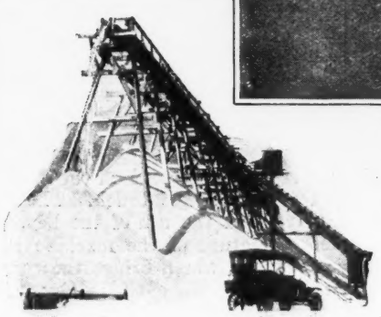
Figure Floating Is the Latest Water Sport

Roads worn far below the surface of the fields by the passage of innumerable feet, as a river slowly wears its way through rock in producing a canyon, are to be found in remote provinces of China. Wind, carrying away the dust of traffic aids in producing a deep cut such as that shown above

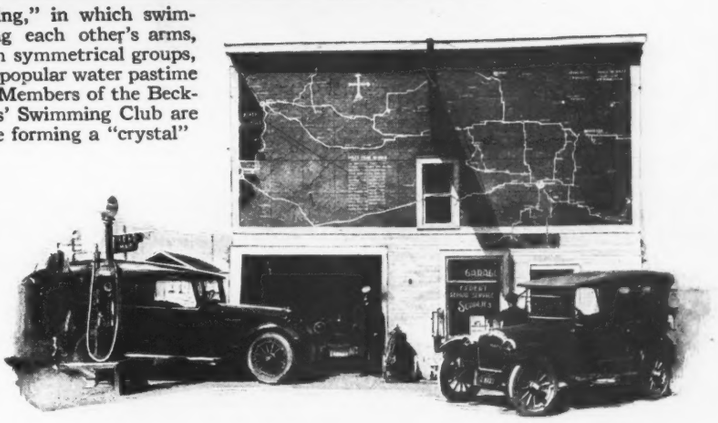


"Figure floating," in which swimmers, grasping each other's arms, and legs, form symmetrical groups, has become a popular water pastime in England. Members of the Beckenham Ladies' Swimming Club are shown above forming a "crystal"

An automobile can be used as a duck blind without the slightest attempt at concealment, it was found last season, provided the hunters keep out of sight or sit very quietly in the car. Sitting still in a duck boat is not always easy, but hunters should be able to remain motionless in a comfortable auto

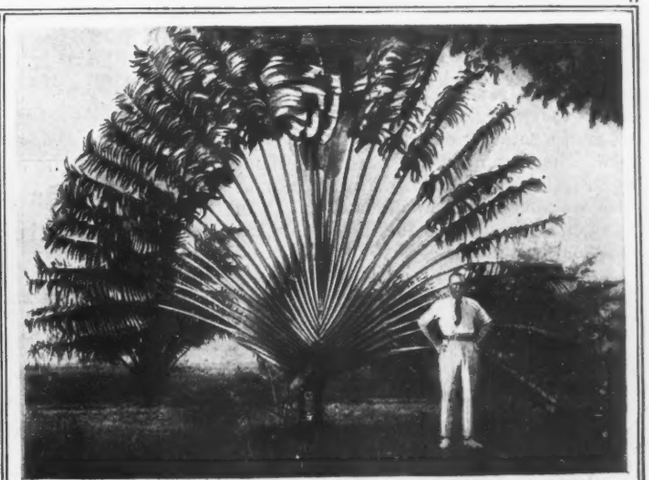


Twenty thousand tons of pure table salt, stored in piles in the open air, is the season's "crop" from a 1000-acre "salt farm" on the California coast. The salt is handled by conveyors like sand

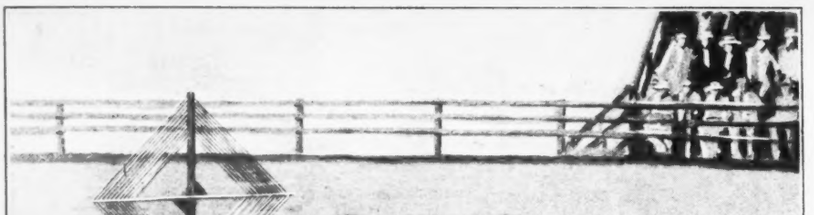


For the benefit of tourists, an automobile map measuring 10 by 20 feet adorns the front of a garage in a small South Dakota town. The map, in colors, shows the available roads for many miles

In this factory ramps hold the running gear at convenient height for final assembly. Tractors depart under their own power



This "travelers' palm," in Nigeria, West Africa, gets its name from the fact that each branch provides a drink of water



Racing Cars Will Signal the "Pit" by Radio

RACING cars equipped with radio sets for sending and receiving will soon participate in long distance motor classics. The antenna will be strung along the streamlined tail piece and communication will be maintained throughout the race by head phones and transmitter slung over the mechanician's head.

Louis Chevrolet, one of America's best known drivers, who is equipping his car in this manner, expects to save many minutes by being able to signal the "pit" when he intends to stop for new tires, gas, and oil.

For ordinary road work the outfit is grounded at a convenient hydrant, but during contests a "ground" will be obtained by utilizing the automobile engine and frame. In preliminary tests the speedway radio outfit has already demonstrated its usefulness.

Typewriter Prints Whole Word at a Touch

TAKING advantage of the fact that 22 words constitute 31.8 per cent of all the words in common use, an inventor has perfected a typewriter the keys of which print whole words instead of letters. The machine is said to save 20 per cent of the typist's time. As one instance, the key with the word "and" may also be used in combination with single letters to produce "sand," "land," "grand," etc. For mercantile houses where commercial abbreviations recur frequently the specialized characters may be placed on the keys and printed with a single touch. The word keys are around the rim of the keyboard.

The new word writer

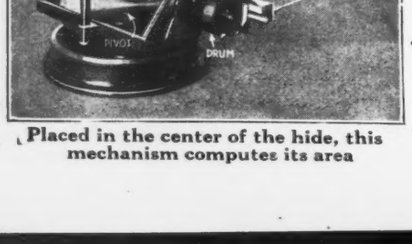
Word keys can be combined with letter keys to form longer words

Another feature of the machine is the carriage return, which brings the carriage back to the beginning of the line by a slight movement of the little finger.

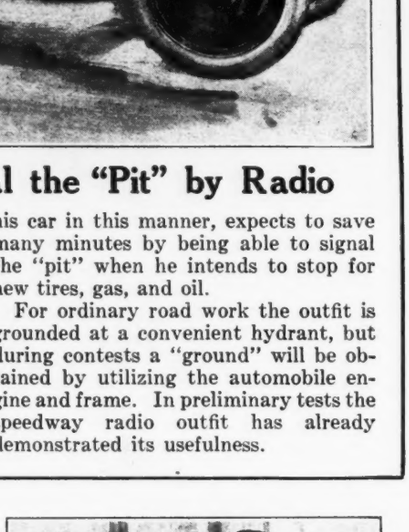
Gage Gives Area of Hides as Pin Traces Edge

SIMPLIFIED, compact gages for measuring the area of tanned hides have just been perfected to take the place of the complicated and expensive devices formerly used. The instrument, placed approximately in the center of the hide, has a heavy circular base of cup shape, the center pin of which forms the pivot for the rotatable superstructure of the measuring mechanism. Around a spring roller, two chains of equal length are wound, the ends of which are attached to the pin that the operator moves in a vertical position along the edge of the hide. The two chains are kept taut.

As the pin is moved around the outline of the hide, the entire superstructure makes a complete revolution around its center pivot. This revolving motion is transmitted to the calculating mechanism by means of a rotating cone through a contact disk. The ingenious calculating mechanism translates the geometrical values of these motions and compounds them, so as to indicate the area of the hide in square inches or centimeters.



Placed in the center of the hide, this mechanism computes its area



Deadly Gas Protects Vault from Safe Cracksmen

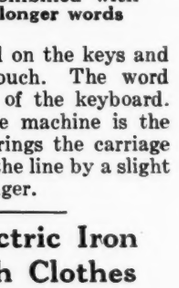
A FRAGILE glass container filled with deadly gases and attached to the door of a safe or vault is a device invented by Walter C. Beckwith, of Fostoria, Ohio, for protection against safe cracksmen and burglars.

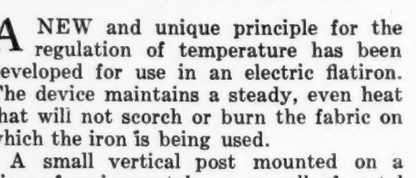
The container and its holder are locked to the safe directly over the crack between safe door and jamb. Any movement of the door or an unusual jar, such as might result from an explosion, breaks the bulb and releases the fluid, which kills instantly. Any attempt to remove the protection by drilling it from the door also breaks the vial.

New Style Electric Iron Cannot Scorch Clothes

A NEW and unique principle for the regulation of temperature has been developed for use in an electric flatiron. The device maintains a steady, even heat that will not scorch or burn the fabric on which the iron is being used.

A small vertical post mounted on a piece of spring metal over a cell of metal alloy is connected with the current switch. When the heat of the iron melts the alloy, the spring tilts the post, which breaks the circuit. As soon as the molten mass is cooled again to a solid, the post is drawn back to its normal position and the electric circuit is closed.





The circuit breaking post, shown in diagram, and its position in a flatiron shown in cross-section

Wonder Microscope Aids War on Germs

Marvelous New Instrument, Using Ultra-Violet Rays, Photographs Wriggling Microbes Enlarged 12,000,000 Times

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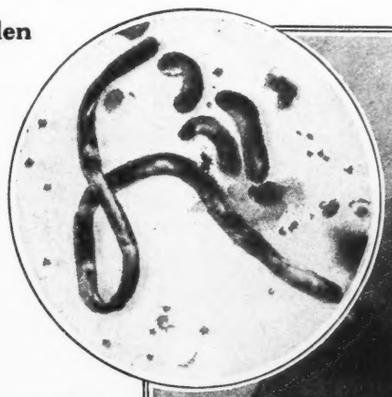
By Wilfred S. Ogden

IN THEIR relentless war on microbe-bred disease, scientists now have at their disposal a powerful new weapon in the form of a marvelous microscope that, by employing "dark light" — invisible ultra-violet rays—faithfully photographs the form and structure of *living* bacilli magnified 12,250,000 times!

The importance of the new instrument, perfected by Dr. J. E. Barnard, in charge of the British National Institute of Medical Research, lies in the fact that it shows sharply the living microbe 12 times larger than do other microscopes, which, in addition, reveal the tiny disease breeders only as dyed and shriveled corpses.



Anthrax germ under Barnard's microscope

Minute markings, never before disclosed, can now be studied. In fact, the results so far obtained by Doctor Barnard by the use of ultra-violet rays seem to open up possibilities for the observation and photography of figures and events in the mysterious microscopic realms of the universe. In his experiments Doctor Barnard first used violet light, then the ultra-violet rays that gave him still better detail; and now he is experimenting with "soft" X-rays—weak X-rays that do not penetrate bone—the wave length of which is shorter than that of the ultra-violet rays. Possibly it will be only a matter of time before radiographs will be available, revealing heretofore hidden details in the structure of these microscopic enemies of man.

Only a short time ago the accurate results obtained by the newest super-microscope were considered just as visionary as these possibilities of the future may seem today. For years the microscope has been limited to a useful magnification of 1000 diameters, or an enlargement of a million times. Beyond that point it has started to break up light itself, giving a larger image but no more details.

Invisible Light Preserves Details

Doctor Barnard has preserved details along with greatly increased magnification by the employment of ultra-violet light, which shows up the microbes in relief, because they are less transparent to ultra-violet rays than to ordinary light, and increases resolution or definition, because of the shortness of its wave lengths.

Resolution depends upon two principal factors. One is the diameter of the aperture of the objective, which governs the amount of light admitted. The other factor is the wave length of the light used. The wave lengths of the different colors that constitute white light vary. As we approach the violet end of the spectrum the wave lengths become shorter. Those of ultra-violet rays are extremely short, and those of radium rays the shortest known.

In his experiments Doctor Barnard met and overcame a number of obstacles. First, ultra-violet rays will not pass through ordinary optical glass, and it was necessary to construct all the microscope lenses of quartz or fluorite crystal, to permit their passage.

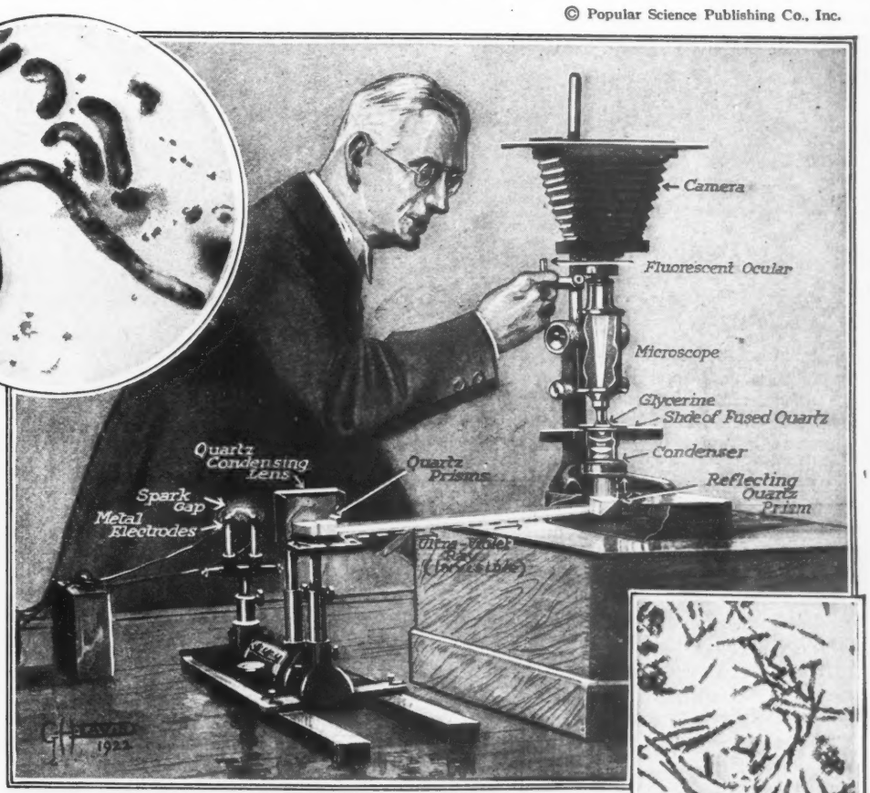
Since ultra-violet light is invisible, its presence is only made manifest by its effect on a photographic plate or on a fluorescent surface. This necessitated a special eyepiece fitted with a fluorescent disk and (in the case of photo micrographs) specially prepared photographic plates with a minimum amount of gelatin on the surface, as gelatin is also impervious to the rays. Again, for certain powers of magnification, it was found necessary to insert glycerin between the object and the microscope, to occupy what would otherwise be an air space, thus providing continuity for the rays between the quartz condenser, the quartz slide containing the specimen, and the objective. Glycerin possesses about the same refractive index as quartz crystal, and permits passage of ultra-violet rays.

To obtain an idea of the instrument as a whole, picture a powerful microscope, with all lenses and other portions through which invisible ultra-violet rays have to pass, of quartz crystal. Where in the ordinary microscope the eyepiece would be, is a camera, mounted on a vertical rod so that it can be swung round. On the same shaft is mounted a special eyepiece—known as the "fluorescent ocular"—for the purpose of focusing.

Rays from Spark Separated

To obtain the ultra-violet rays, Doctor Barnard uses a two-inch electric spark between electrodes consisting preferably of cadmium or osmium. By means of a complex arrangement of prisms, not only is the visible spectrum of the spark obtained, but the ultra-violet rays, in which there is a considerable range of wave lengths, are separated so that rays of only one wave length may be employed.

Thus, after the rays from the spark have been condensed through a quartz lens, they pass on through two quartz prisms that split them into their various wave lengths. One of the rays is caught and thrown upward into the microscope by a quartz reflecting prism and so on to the object under examination. The photo micrograph is taken by the camera in the usual manner.

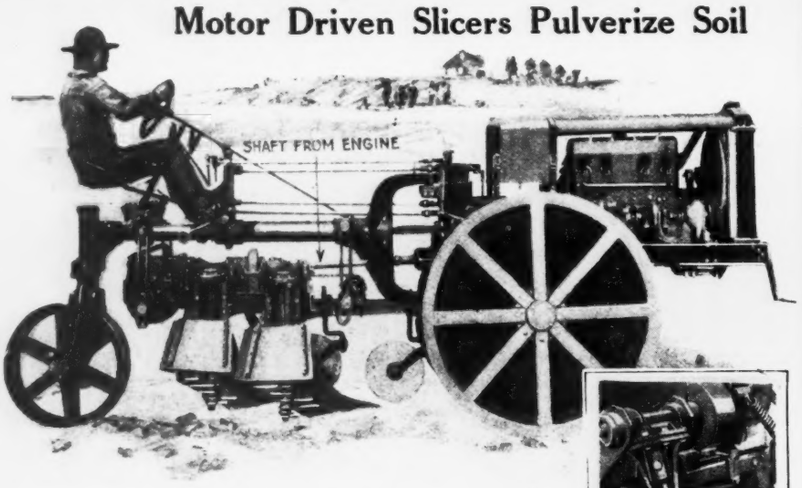


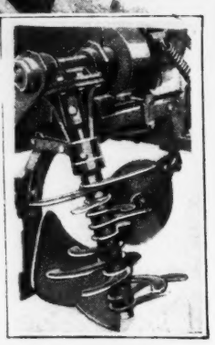
Anthrax germs under ordinary microscope

The Powerful New Microscope at Work

IN THE circular inset is a photo micrograph of the *living* germ of anthrax, magnified 12,250,000 times, taken by means of ultra violet rays in the new Barnard microscope pictured above. Compare this photograph with the one at the right representing the best results previously obtained—a photograph of *dead* and stained anthrax germs magnified only 1,000,000 times. In the new instrument ultra-violet rays, produced by an electric spark, are condensed through a quartz lens, then split up by quartz prisms. One of the rays is then reflected upward through the slide to be examined and the microscope with the attached camera

Motor Driven Slicers Pulverize Soil





Rapidly revolving slicers, shown in the inset, tear into the furrow. They are driven by the tractor motor

A TRACTOR-TILLER, invented by Thomas William Hicks, of Minneapolis, Minn., chops the soil like meat in a rotary chopper, accomplishing more work in a day, it is claimed, than three men with two tractors hitched to five ordinary plows and harrows.

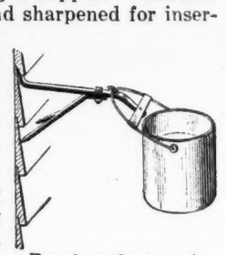
After the plowshare enters the top soil and turns over a furrow, two slicers making 500 revolutions a minute, chop and mangle the soil, weeds, humus, and stubble, leaving the earth in a thoroughly pulverized state.

Power is supplied by a four-cylinder tractor motor that drives the slicers as well as the tractor. When the ground has been prepared for the seed bed, a special grain drill attachment sows the seed, spreads lime and fertilizer and finishes the job by packing down the seed furrow with a layer of soil.

Bracket for Paint Pail Fastens on Wall

HOUSE painters and outside decorators will appreciate the portable paint pail bracket recently perfected by Dale Van Horn, of College View, Nebr.

The bracket is made of light strap iron arranged in the form of a staging support. One of the sides of the triangle is split to form a straddle legged support. Another side is turned up and sharpened for insertion between two adjoining rows of clapboards. A clip on the end of the horizontal member holds the pail handle, the second point of leverage being provided by a long narrow plate on which the pail rests.



Bracket fastened to clapboards

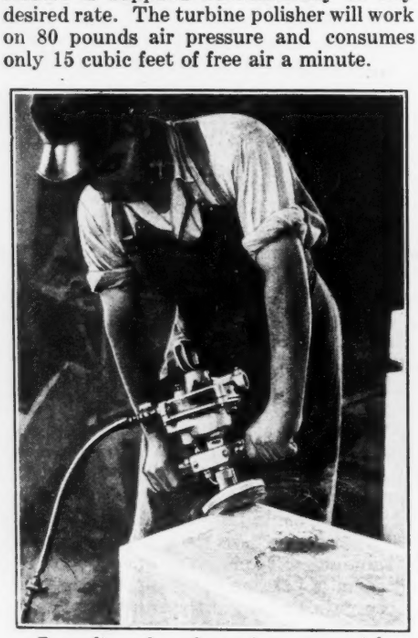
The prong is forced up under a clapboard and the weight of the device drives the straddled legs into the wall below. The action of the bail clip and the narrow plate is to hold the handle away from the pail, giving the workman free access to the paint.

To remove the holder the painter grasps it near the outer ends, lifting it away from the building. The prong comes away without wrenching or twisting.

Rotary Stone Polisher Is Driven by Air

ROTARY air-driven stone polishers that do the work in one tenth the time required by hand polishers have been perfected by a Cleveland company to meet the needs of the monument industry.

The heart of the machine is an air turbine wheel made in a single piece and tooled so accurately that it rotates at high speed with only 1/32-inch clearance all around. By means of a universal holder a tool can be substituted quickly. Water for the cutting surface is supplied automatically at any desired rate. The turbine polisher will work on 80 pounds air pressure and consumes only 15 cubic feet of free air a minute.



Rounding the edges of a stone with the air driven polisher

Lamp and Copy Holder Combined for Typist

A COMBINATION lamp and copy holder recently placed on the market serves the double purpose of giving an adjustable support to the notebook of the typist and a light for reading the notes without eye strain.

The apparatus has a double ball-and-socket base that may be screwed to the typewriter table or stand. In one of the sockets rests the ball of the lamp holder, in the other that of the copy holder. Each arm is double jointed and can be adjusted to any desired position.

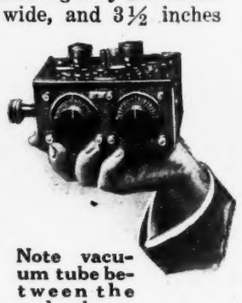
The lamp is shaded so that the eyes of the typist are protected from the glare and the copy holder is provided with a slideable guide that can be moved from line to line as the work progresses.

Another type of the same appliance can be fastened to the wall instead of to the table or desk.

Vacuum Tube Radio Set only Six Inches Long

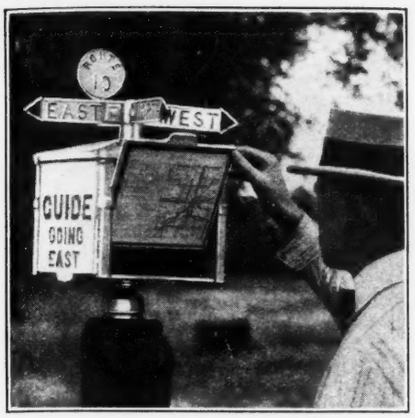
VACUUM tube radio receiving outfits comprising a complete tuning unit and a regenerative or feed-back vacuum tube circuit, yet measuring only six inches long, three inches wide, and 3½ inches high, have been produced by a French radio firm.

The knobs and switches for varying the tuning coils are placed on top of the small case. Each knob has 11 points. The vacuum tube socket is located between the two knobs.



Note vacuum tube between the knobs

Two variable condensers, one in series with the antenna and ground and the other connected across the secondary of the inductance, provide means for fine tuning. Binding posts for all connections are placed on the front face of the cabinet. The entire cabinet weighs only 2½ pounds.



Road Maps by the Wayside Guide the Tourist

LOST roads and blind detours will be things of the past when a highway guidepost invented by Albert Ruebsamen, of Decatur, Illinois, comes into general use.

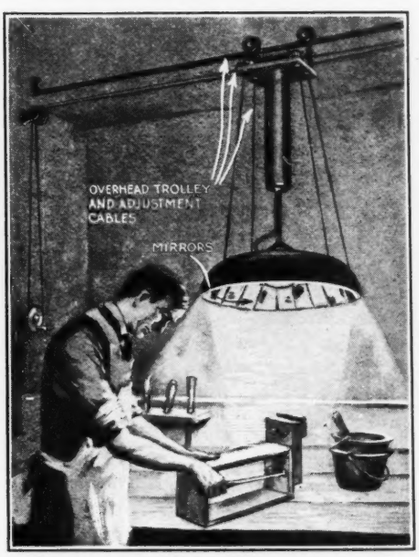
Mr. Ruebsamen's invention comprises a glass sided box perched on a post for installation beside the highway. Four glass faces present maps mounted behind watertight glass. Each map gives details of routes leading from its location with full information about garages, hotels, and camping spots. By pivoting the box the tourist can swing any one of the glass faces into convenient reading position.

New Lamp for Workbench Casts No Shadows

LAMPS that cast no shadows on the workbench, but concentrate the illumination upon any part of the work, from any angle, have recently been invented.

The principle involved has been used to some extent in the lamps used above billiard tables. A circular frame holds a series of small mirrors within its rim, so that the light is concentrated into a cone that lights all sides of the object equally. Instead of being divergent, the rays converge toward a point.

The fixture is arranged to travel on an overhead trolley. By pulling upon any one of four adjusting cords attached to the rim of the shade, the worker can make the beam of light fall from any angle or height.



By an ingenious arrangement of small mirrors shadows on the work are entirely eliminated

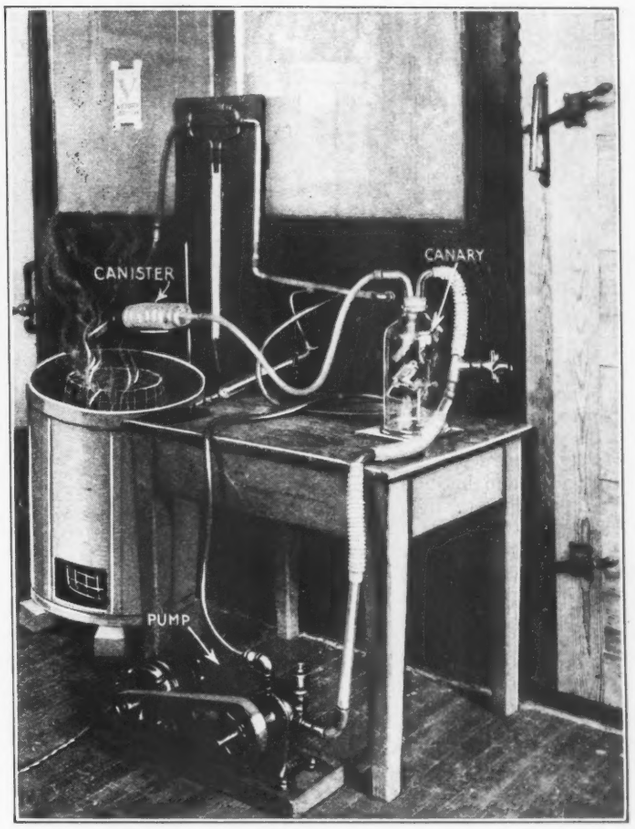
Canaries Gassed to Test Safety of Masks

IN TESTS to determine just what protection an army gas mask will give against certain gases encountered in industrial accidents, the United States Bureau of Mines has been "trying it on the canary."

A test is conducted in an air-tight room lined with sheet metal and inclosing a special measuring apparatus. A fire is kindled, and a suction pump draws a certain amount of the fumes through the canister of a mask into the glass compartment containing the canary.

The canary is so sensitive to noxious fumes of all kinds that the protection given by the mask can be estimated with accuracy.

The experiments showed that the army gas mask will protect from suffocating smokes and gases of fires, but will not assure protection from carbon mono..id.



Drawn by a pump, poisonous fumes pass through the mask canister into a compartment containing the bird

Camp Heater Torch Can Be Packed into Kit

FOUR hours on a pint of gasoline is the fuel consumption record of a combination blowtorch, soldering iron and camp heater. The outfit consists of a cylindrical chamber where the fuel is compressed by means of a hand plunger and a burner to which different tips for soldering may be attached.

A heavy cotton wick leading from the fuel chamber to the atomizer assures an even flow of gasoline when the torch is held in any position. For camp use the flame can be directed against the cooking utensils and adjusted to provide any degree of heat.

The device weighs only two pounds with a length of 17 inches and a diameter of 1½ inches. This size makes it possible to pack the torch in the average tool box or kit, and thus it is an ideal heating unit for an automobile camping trip.

Soldiers Ride a Six-Foot Ball for Exercise

ACROBATICS atop huge pushballs are taking the place of the stereotyped forms of setting up exercises at some of the army camps. One soldier climbs on top of the six-foot sphere and endeavors to hold his balance while his comrades manipulate the ball first one way and then the other in an attempt to dislodge him.

When one soldier slides off, another takes his place. A stop-watch held by a referee times each man's ability to cling to the ball.

How long can he stay on top of the ball, while others roll it?

THE only foods that attack the surface of aluminum cooking vessels are oranges, lemons, brussels sprouts, and tomatoes, according to Prof. John Glasier of Glasgow University, Scotland.

Toy Balloon Sails 102 Miles in Contest

Distances covered by toy balloons that made the longest flights from Antwerp, Belgium, are indicated in the map below. Entries in the contest, just before 4000 balloons were released, are shown in the photograph

A PEASANT in Duisburg, Germany, was surprised recently to see a toy balloon come bobbing out of the air and drop in his yard. Attached to the little aircraft was a postcard carrying the request that the finder sign his name and return to a department store in Antwerp, Belgium, 102 miles away. For this the peasant received first prize in a contest conducted by the store. Of 4000 balloons released, the one alighting in Duisburg carried the farthest.

Considering the fact that the balloons were released on a day when rain fell heavily, the distances covered were remarkable. The second prize entry covered 91 miles and the third, 81 miles. Many more traveled over 25 miles before being forced to earth by gas leakage.

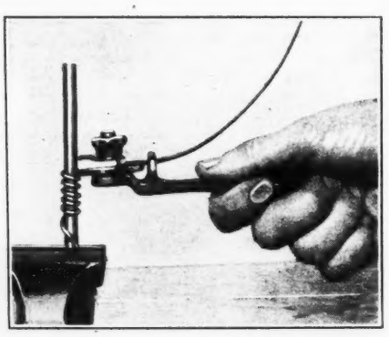
Stretching Machine Used to Treat Clubfoot

ONE of the machines invented and employed by Dr. Adolph Lorenz, famous Viennese "bloodless surgeon," for the treatment of the disease known as clubfoot, is being used with success by American physicians in the cure of such cases. The machine was left in America by Doctor Lorenz when he returned to Europe.

Cure of clubfoot in extreme cases of long standing is practically impossible, and even radical surgical operations can seldom produce more than slight improvement. But if treatment is begun while the afflicted person is young, the orthopedic adjustment practised by Doctor Lorenz is often followed by beneficial results. For this treatment Doctor Lorenz invented his machine.

Fastened in the machine, the deformed foot is slowly drawn into shape

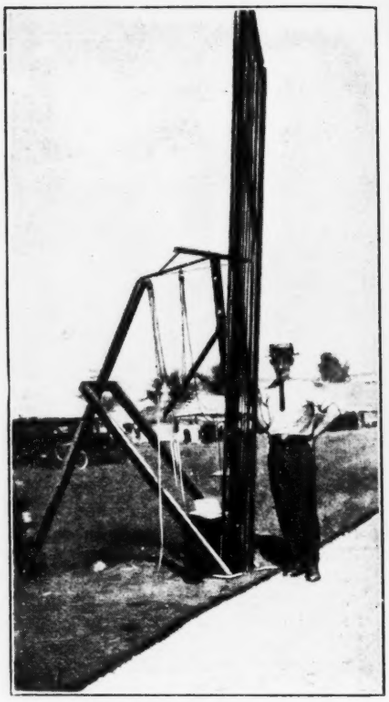
The crippled foot of the patient is firmly fixed in the apparatus and then the displaced parts are gradually drawn and twisted into the proper position. In this way the contracted tendons, muscles and ligaments are by slow degrees stretched, so that they permit the bones of the foot to assume a normal position.



Hand Tool Coils Wire Springs Evenly

WIRE springs of any material and in any moderate diameter and pitch can be quickly and evenly wound by a hand precision tool now on the market. The spring winder consists of a handle, one end of which terminates in a friction chuck for holding the wire as the spring is built up, and an adjustable guide that can be set for any desired pitch of winding.

The end of the wire, threaded through the tool, is caught in a vise that also holds the mandrel.



Tug on a Cord Closes Automatic Gate

OPENED from any convenient distance by a light tug on a cord, an automatic collapsing gate, invented by Bernard L. Todd, of Des Moines, Ia., will rise through snow or mud and operate in the winter as well as in the summer. When closed, the gate, five feet high and constructed of metal, lies in a horizontal position. When swung to one side, the bars close into a vertical mass.

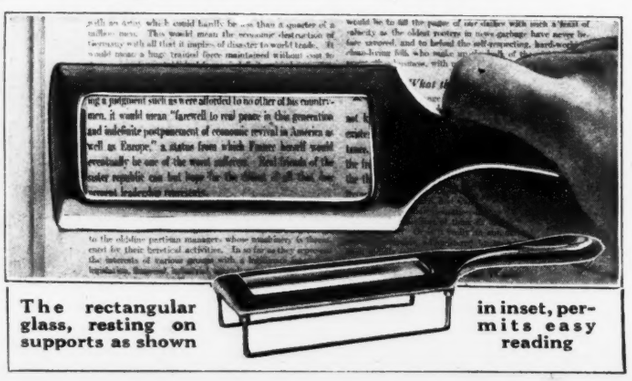
Instead of springs or ratchets, an adjustable weight is used. This is heavy enough to raise the gate after it has been lifted the first few feet by a pull on the cord. This device is successful because as the bars start to fold together, the center of gravity of the gate moves rapidly toward the gatepost, and the weight soon overbalances the gate. The latter, however, is heavy enough to remain firmly in place after it has been lowered.

Colored Nets Fool Fishes

BECAUSE fishes are "wise" enough to steer clear of white nets, fishermen of Dalmatia color their nets with brown and bright green dyes, extracted from the bark of plants. Into these nets the fishes swim unsuspiciously, possibly because the green and brown nets resemble sea-weed.

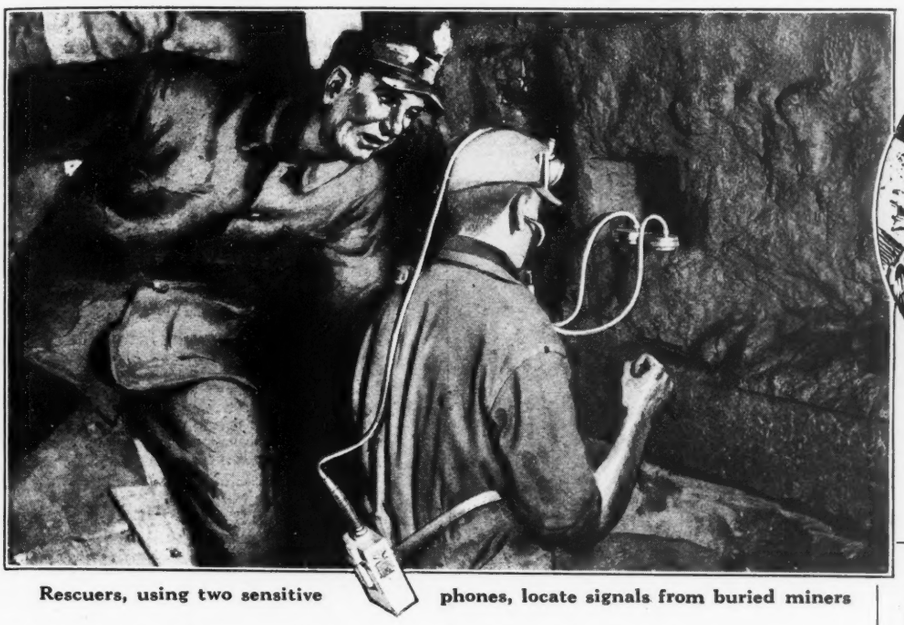
Oblong Reading Glass Focuses Itself

A MAGNIFYING glass that rests on its own support the proper distance away from the object to be magnified represents an important improvement over the old fashioned hand-held glass. The new glass is rectangular instead of circular, permitting a greater amount of reading while the glass is in one position.



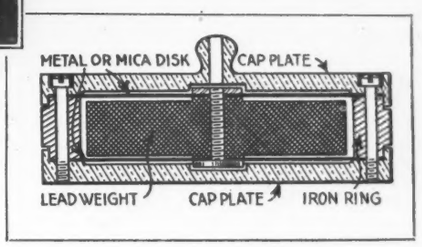
The rectangular glass, resting on supports as shown in inset, permits easy reading

Tests Prove Value of Geophone in Mine Rescue



Rescuers, using two sensitive phones, locate signals from buried miners

How the geophone, pictured in diagram below, is used to locate miners trapped hundreds of feet below the surface of the earth



RECENT tests by the United States Bureau of Mines have revealed the effective range of the geophone, a sensitive sound detecting instrument used during the war, in aiding the work of rescuing miners trapped far below the surface during mine disasters.

The tests proved that the geophone would detect sounds of a sledge through coal veins from 800 to 1200 feet away. Through the earth cover of mines the sledge could be heard 300 feet distant. Other operations, such as tamping, dropping rocks, and shoveling, could be picked up at distances varying from 175 to 1000 feet, depending on their nature and the terrain through which the vibrations were forced to travel.

By setting up two geophones at some distance apart and noting the comparative strength of the sounds it is possible to locate the victims of a mine disaster.

The geophone is a refinement of the microphone type of telephone receiver. It consists of a small cylindrical case about one inch high and three inches in diameter in which two mica or metal diaphragms support a relatively heavy lead weight. From the diaphragm chamber a small opening terminates in an attachment for a rubber tube leading to the ears of the user.

In practice, two geophones are used. They are placed on solid earth in an upright position. If the earth in any direction is being tamped or shocked, the vibrations are transmitted to the geophones. The thin membranes communicate the vibrations to the observer's ears.

Ultra Violet Rays Used to Cure Sunburn

ACTING on the theory that "like cures like," physicians at the Broad Street Hospital, New York, claim to have obtained encouraging results through the use of the equivalent for sunlight, in healing sunburn produced by too many hours at the seashore.

The properties of sunlight, according to Dr. A. J. Barker Savage, superintendent of the hospital, are virtually reproduced by a newly designed lamp that throws off ultra violet rays. These rays, says Doctor Savage, kill bacteria and gradually heal the burned and injured tissues.

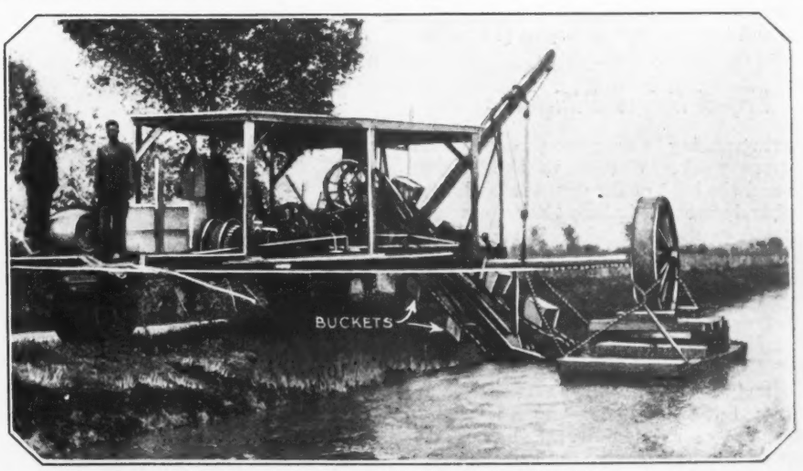
When under treatment, the patient wears glass goggles to protect his eyes, just as he would in the bright sunlight.

Dredger Truck Cleans Irrigation Ditches

FOR cleaning irrigation ditches in agricultural districts, a newly designed bucket dredge mounted on a three-wheeled truck that pulls itself along the side of the ditch by a cable, has been found to be simple and economical in operation.

The working parts of the machine include a two-cylinder gas engine of 15 horsepower which operates the bucket dredge, and a drum on which the propeling cable is wound. The free end of the cable is fastened to a stake driven into the bank, and as the cable is wound on the drum, the machine pulls itself toward the stake.

The single front wheel of the truck is a roller. In the rear are two wheels mounted on a long axle, which extends far beyond the platform truck. This makes it possible for the rear wheels to straddle the ditch unless it is too wide. In that event, the extension wheel is strapped to a pontoon. The operation costs are between $183 and $365 a mile.



When the ditch is too wide for the machine to straddle it, one of the rear wheels is lashed to a pontoon, as shown above

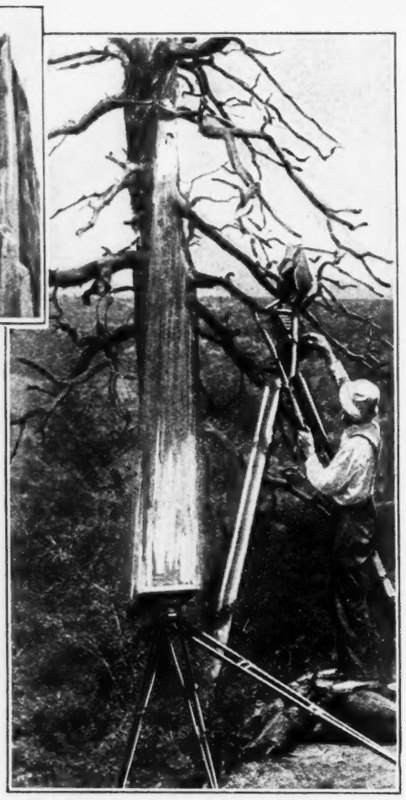
Camera Man Ambushes the Elusive Saw-whet Owl

A TRIPOD, with legs nearly 12 feet long, to elevate a camera to otherwise inaccessible positions, and an adjustable mirror to throw rays of sunlight against dark nest openings, enabled Robert B. Rockwell, a bird lover of Denver, Colo., to obtain the remarkable photographs of the rare saw-whet owls shown on this page.

The large mirror, which Mr. Rockwell says is one of the most indispensable parts of his outfit, is fitted upon a tripod with an adjustable head, permitting the photographer to throw a brilliant beam of light on any object that is in shadow, and thus making fast exposures possible. Through its use he obtained bird pictures that otherwise would have been photographic impossibilities.

Remaining specimens of the saw-whet owl usually make their home in hollow stumps and dead tree branches in the most deserted sections of the country and few of them are ever seen except by chance.

Framed by the entrance of an old woodpecker's hole was the face of a saw-whet owl, calmly surveying the intruders. In this nest were found four white eggs



Twelve foot camera tripod, and mirror to reflect sunlight on shady spots, used in photographing the young saw-whet owls

These baby owls were found in one nest. The difference in their size is due to the fact that the eggs are laid at intervals of two or three days, resulting in similar irregularity in the time of hatching. The fledglings show no fear even when they are handled and petted

Camera Makes a Daily Record

It was Mr. Rockwell's fortune to come upon a nest at a time when four eggs were nearly ready to hatch, and his camera recorded day by day the rapid growth of the fledglings. The nest was found in an old woodpecker hole in a dead yellow pine tree in the Wildcat Point country, about 25 miles south of Denver. Framed in the hole was the face of Mrs. Owl, calmly surveying the intruder. Climbing the tree, Mr. Rockwell and his companion carefully cut out a piece of the wood below the entrance hole to permit a view of the interior. At the bottom of the nesting cavity, which was about 10 inches deep, were found four white eggs lying in an accumulation of chips.

Nailing the piece of trunk back into place, Mr. Rockwell departed, to return to the nest again about a month later. On this trip he was rewarded by finding four tiny birds. The young ones differed strikingly in size, the largest one being fully twice the size of the smallest. This fact, according to Mr. Rockwell, seemed to substantiate statements that the eggs of this owl are laid at intervals of two or three days, and that incubation begins as soon as the first egg is deposited.

Tripod Solves Difficulties

Photographing the young ones was strenuous work. Unused to the bright light and the heat of the sun, the birdlings wilted and were able to keep their eyes open only a few moments at a time. They opened their beaks, panted violently, and were always moving, making anything but instantaneous photography impossible. Use of the long-legged tripod and mirror finally resulted successfully.

When first born the saw-whet owl is an exceedingly small bird with actions like a chicken; but within a few weeks it grows to the size of its parents. Unlike most others of the owl family, the saw-whet is not a fighter. The murderous beak is present, but it is seldom used.

How to Disguise a Camera

DULL green and brown screens of thin cambric, with a hole cut in each to fit tightly about the lens tube, form an effective disguise for the camera in bird photography, according to Herbert Keightley Job in his new book, "How to Study Birds," (The Macmillan Company.)

"Most birds are afraid of a camera set near the nest," says Mr. Job. "But most of them will return before long if the instrument is properly disguised."

From actual experiences Mr. Job offers many practical suggestions to camera hunters for successful bird photography.

Power Saw Turns Driftwood into Cash

ON ONE of the sheltered shores of San Francisco Bay, is a diminutive firewood plant that is successfully turning driftwood into commercial kindling.

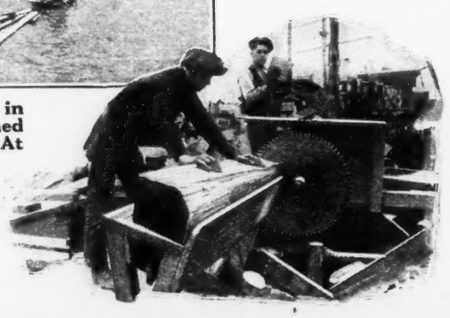
Forty dollars a day, filtered from the ocean tides, forms the livelihood of C. M. Stoneburner, of Oakland, Calif. Waste that others passed by, Mr. Stoneburner has utilized as the foundation for a lucrative business. In his back yard the waters of San Francisco Bay daily bring a new supply of floating driftwood that, with the aid of a power saw, is turned into stove length fuel that sells readily at a good price.

The drifting timbers consist of pier dolphins that have been eaten off below water level by marine borers, wreckage, logs, and the thousand odds and ends from industrial plants along the water front and the streams that empty into it.

Some of the lumber is 20 feet in length and several feet in diameter. The drift timbers are sawed into lengths varying from eight feet to 16 feet, then rolled up a steplike incline by means of a rope. The largest are split into halves or quarters with wedges and sledge hammers. The rest of the work is done on an ingenious saw table. This table is a rocking frame with a 14-inch top and a four-inch upright back piece, which holds a log against the blade of a rotary saw permanently stationed at one end of the table on a separate framework.

The rocker table moves forward and backward between stationary guides over a balancing point. To accomplish this, the table is made with only two legs, both of which are pivoted at the bottom on a long iron pipe acting as a central shaft of rotation. Thus the pipe is the center of a circle of which the legs and table are the radius, as the log describes a circumference which bisects the buzzsaw. A saw capable of cutting a 12-inch log is driven by a gas engine of about four horsepower at 800 revolutions a minute.

Two men can easily cut up four cords of block wood a day. This brings the operators $40 for a day's work, a tidy bit of "drifting cash."



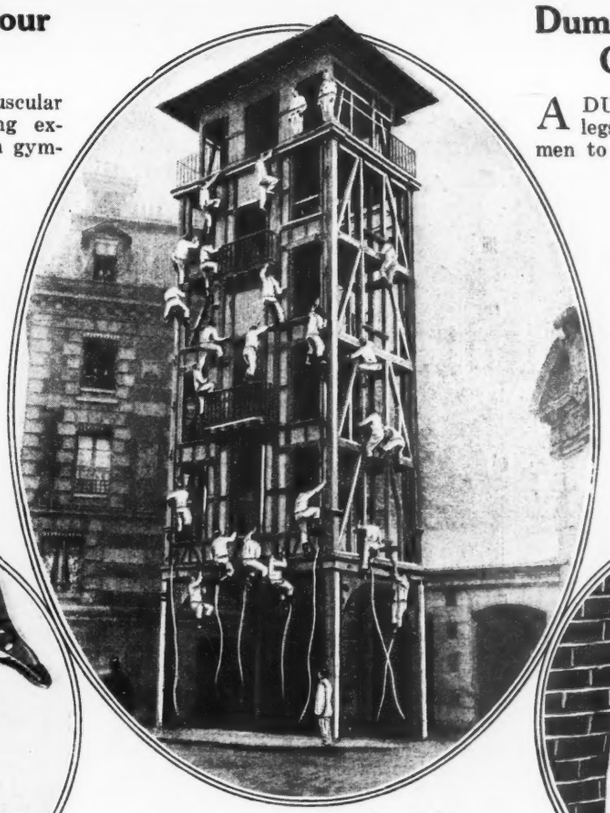
Above: Towing in flotsam to be turned into firewood. At the right: Cutting a 10-inch timber held on the ingenious rockertable

Can You Stand on Your Upper Teeth?

ONE of the most amazing muscular feats ever performed is being exhibited by Gladys Portia, a woman gymnast, who can support her entire weight by her upper teeth alone. Upside down, bent almost double, and with only the grip of her jaws on a rubber pad to sustain her, she is able to maintain this position for more than a minute by her remarkable sense of balance.

The remarkable development of the muscles of the neck and throat, as well as those of the jaws, necessary for this trick of balancing, can readily be seen by comparing the line from the chin to chest with that of an ordinary person standing with chin raised in the air.

Extraordinary flexibility of muscles is required to perform this unusual feat



Firemen Display Skill

FIREMEN of Paris recently built a special tower on which they gave a spectacular exhibition of skill in performing daring feats required in fire fighting, such as scaling walls with ropes and ladders, climbing sides of buildings from sidewalk to roof without aid, jumping into nets, erecting long ladders, and passing hoses.

Dummy Cow Teaches the City Man to Milk

A DUMMY cow built of four wooden legs and a canvas sack, to teach city men to milk, is helping to solve the unemployment problem in England. Graduates of agricultural training schools are now able to milk a cow properly, although they may never have seen one.

The sack is filled with a liquid having the same specific gravity as milk, and the rubber teats of the training machine are ingeniously constructed to act like those of a real cow under pressure of the milker's hands.

Except for the lack of a tail to whip into the milker's eyes and the ability to put its foot into the bucket, the machine is for all practical purposes a faithful likeness of nature.

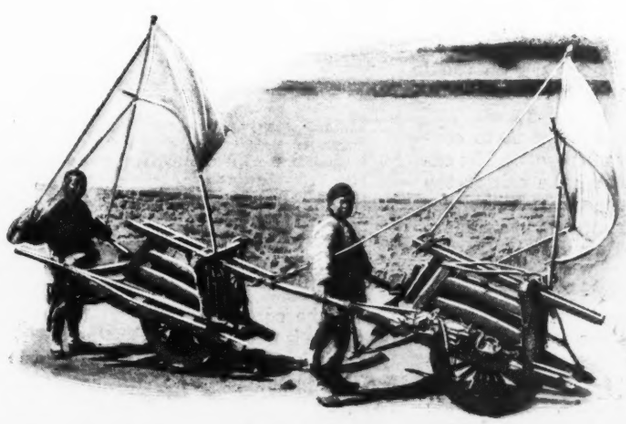
The substitute cow is a canvas bag supported by four wooden legs

Sail Pushes Chinaman's Wheelbarrow

THE wheelbarrow is still the Chinaman's motor truck because the footpaths of the interior cities of China are usually too narrow for any other vehicle; but the Orientals are progressive enough to mount sails on their barrows when the wind is fair.

In a stiff breeze, the assistance given by a small square sail in pushing the load is said to be astonishing—in fact, the coolie has little work to do other than to hold the rear of the barrow off the ground and occasionally act as a brake.

The rigging of these sails is elaborate, but while they draw well when the wind is dead astern, the coolies do not attempt to take advantage of a quartering breeze or to tack into the wind. Theoretically, a sail would have some tractive power under even those conditions, but John Chinaman is a highly practical man.



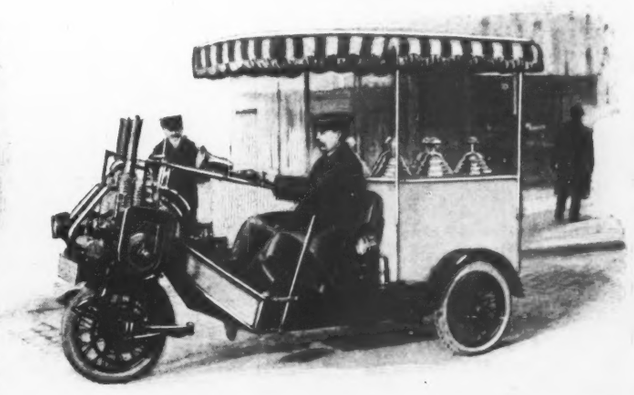
With sails rigged to their wheelbarrows, Chinese coolies "have it easy" when a stiff breeze blows

Ice Cream Wagon Is Motorized

MOTOR driven ice cream wagons are making their appearance on the streets of some cities. Instead of pushing his stand along by hand and calling the children with a bell, as in the older days, the "hokey pokey" man now motors along at 20 miles an hour, and heralds his coming with a whistle or a more elaborate compressed air calliope.

The ice cream car consists of a canopied cart body mounted on three wheels, with the engine over the front wheel. A small motorcycle engine furnishes the motive power, and at the same time drives an air compressor that operates the calliope. The engine is placed as far away from the ice cream as possible, to avoid spoiling the flavor of the cream by gasoline fumes.

The additional customers reached by the motorized cart more than pay the increased cost of operation, it is reported.



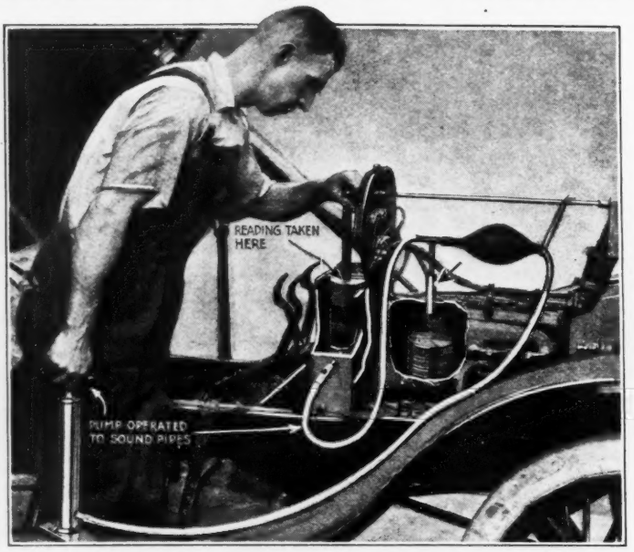
Mounted on three wheels, the "hokey pokey" cart is propelled by a motorcycle engine, which also blows a calliope

"Tone" of Automobile Cylinder Measures Its Volume

A NEAT and reliable method of measuring the cubic contents of automobile cylinders by means of sound has recently been perfected by M. F. Charron-Godet, professor of physics at the University of Angers, France. His invention rests on the acoustic principle that the pitch of the tone produced by vibrations of an inclosed mass of air varies with the volume.

Usually when the owner of an automobile notices that the sound produced by the running of his engine is no longer an even "purr" but has a distinct rhythm or beat and that one or several cylinders "knock," he looks for the cause of the trouble in inequality of the cylinder volumes. He dismantles his engine and measures the cubic contents of the cylinders by pouring oil in one after the other and comparing the quantities required. The results obtained by this crude method of measuring are exceedingly unreliable and the process is undoubtedly "messy."

In the ingenious Charron-Godet measuring device, called the acoustic volumeter, one of two short sounding pipes, which are of the same length and diameter, is connected with the cylinder to be measured. The other is connected with a measuring cylinder with slidable piston, the stem of which is calibrated to indicate the cubic contents of the space above the piston head.



Two sounding pipes, one connected with a measuring cylinder, the other with the cylinder to be measured, are attached to a bellows bulb supplied with air from a tire pump

The free ends of the two sounding pipes are connected by a Y-tube with a tire pump and an interposed elastic bellows bulb.

When the pump is worked and the bellows bulb inflated, the sounding pipes will "speak." If the pipe connected with the measuring cylinder gives a tone of higher pitch than the pipe connected with the cylinder to be measured, the piston rod of the measuring cylinder is drawn out until the tones of the two pipes are exactly alike, producing no perceptible "beat" or trill. The calibration on the rod of the piston indicates the exact cubic contents of the cylinder measured. If the pipe of the measuring cylinder is lower in pitch than that of the tested cylinder, the piston of the former is slowly pushed in until the notes of the pipe are alike.

So exact are the results of this method of measuring, that it can safely be employed to measure the cubic contents of small, irregularly shaped objects or of substances in powdered form which could not be measured otherwise.

Drummer Can Tune Kettle Drum with His Feet

DANCING to jazz music will be more popular now that Adolph Wiedoeft, of San Francisco, Calif., has worked out a scheme by which the tone of the drum's "boom" can be altered at will. Wiedoeft's device is foot operated.

All the tightening clamps are connected through gears with a universal joint that leads to the pedal controls. By pressing on one of the pedals the drum membrane is either tightened or loosened, thus instantly changing the tone. By working all the clamps together an even change in tone is made over the surface of the membrane.

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By pressing a pedal, the drummer adjusts the drum membrane

Crowd Psychology Studied in New Street Car

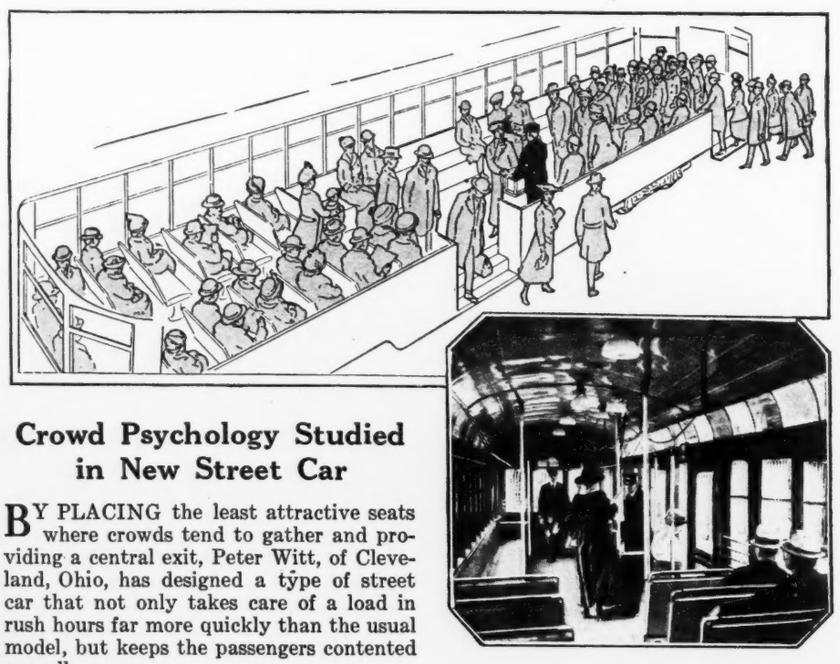
BY PLACING the least attractive seats where crowds tend to gather and providing a central exit, Peter Witt, of Cleveland, Ohio, has designed a type of street car that not only takes care of a load in rush hours far more quickly than the usual model, but keeps the passengers contented as well.

The car is designed throughout to conform to the psychology of crowds. The entrance is at the front and the exit at the center. But the passenger may use either door. If he enters in front, he pays his fare as he gets off. The center door is "pay as you enter."

In the front half of the car, the seats are longitudinal; in the rear, transverse. Since most people get on at the front entrance, they naturally move to the rear to sit in the more comfortable transverse seats. This movement equalizes the load, and the wide aisle in the front section gives space to take on a big load of passengers quickly at transfer points without the usual confusion.

The passenger pays his fare when he passes the conductor's box in the center, even if he is not getting off at that moment. Once in the rear section, with his fare paid, the conductor pays no further attention to him.

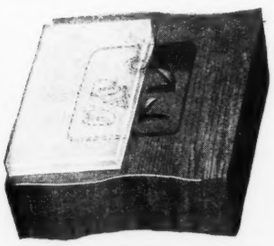
This street car has been used successfully in handling crowds in large cities.



How the arrangement of more comfortable transverse seats in the rear keeps the crowd moving away from the front entrance, is shown in the diagrammatic view. Inset shows interior view of the car

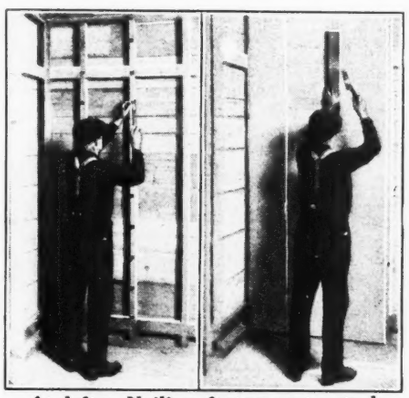
Wallboard Fasteners Do Away with Ugly Nails

SELF clinching fasteners for wallboard, devised by Charles A. Upson, of Lockport, N. Y., eliminate the unsightly nail heads that are always in evidence when wallboards are fastened with nails in the center of panels.

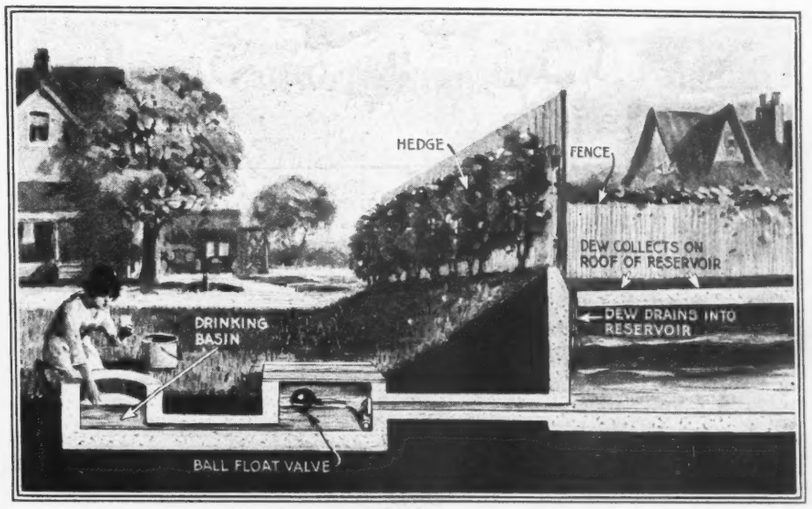


How the prongs, nailed to studding, grip the wallboard

Mr. Upson's invention consists of a small steel plate about one inch square with five prongs pointing in different directions. These are first nailed to the studding of the room. When the wallboard is placed over the studding, hammer blows cause the prongs to penetrate the board and bend over.



At left: Nailing fasteners to studding. At right: Hammering wallboard on fasteners



"Dew Pond" Supplies 120 Gallons Daily

BASED on the principle of bringing moisture laden air in contact with colder ground surfaces inclosed by embankments, a "dew pond" for condensation and storage of atmospheric moisture has recently been invented by S. B. Russell of Gosmore, Hitchin, England. Similar reservoirs are being projected for arid areas of Queensland, Australia.

A dew reservoir 30 feet square will collect 24,000 gallons of water in a year, or an average of 120 gallons daily during the hot summer months and 50 gallons daily for the remainder of the year. This is ample supply for the average farm.

The Russell reservoir consists of a concrete cistern about five feet deep, with sloping concrete roof, above which is a protective fence of corrugated iron which aids in collecting and condensing vapor on the roof and prevents evaporation by the wind. The floor of the cistern is flush with the ground, while sloping banks of earth around the sides lead up to the roof.

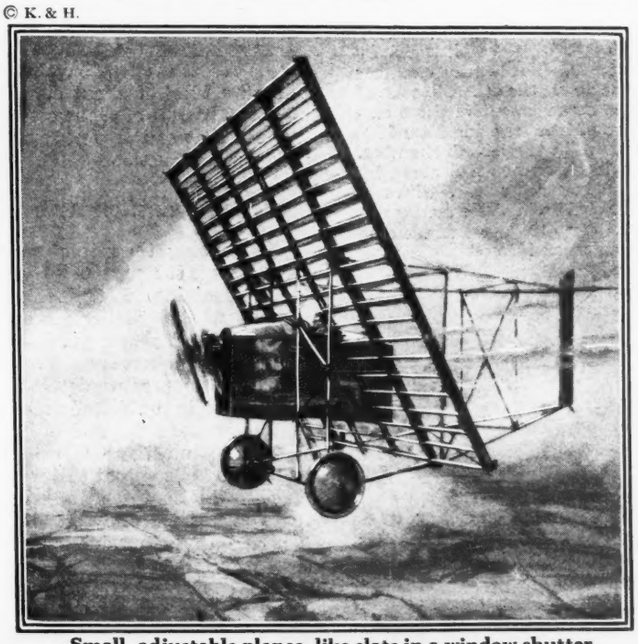
Moisture draining into the reservoir from the low side of the roof maintains the roof at a lower temperature than the atmosphere, thus assuring continuous condensation.

At one side of the reservoir is a concrete basin set in the ground. By means of a ball valve, this basin is automatically kept full of water drawn from the reservoir.

"Window Shutter" Plane Rises from Roof

THE long dreamed of airplane that can both rise from and alight on the roof of a city building is now heralded in a machine of entirely new wing design exhibited recently in Paris. The supporting wing surfaces are composed of a series of small, adjustable planes, each with a chord of about six inches, and arranged like the slats in a window shutter. The machine is made even more peculiar in appearance by a pronounced "stagger" to the wing system.

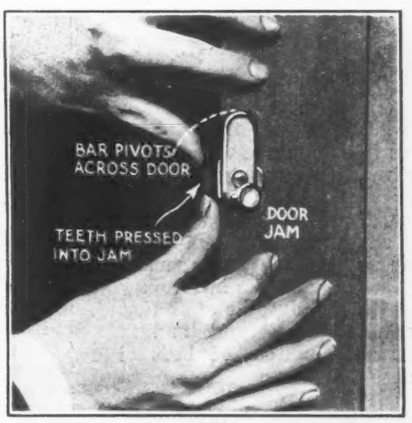
© K. & H.



Small, adjustable planes, like slats in a window shutter, form the supporting wing surfaces

The wing elements are made of thin sheets of duralumin, with a filling of compressed cork, which permits the fireproof metal wing to be shaped.

Instead of using ailerons or flexible wing-tips, the inventor simply pivots each wing. To get the usual aileron control, vertical rods are run from each of the round central spars supporting the wings, and are linked with cranks projecting from each wing. These rods are connected with the controls so that all the wings on one side may be tilted in one direction, and the other side turned in reverse direction.



Wedge in Door Jam Keeps Burglars Outside

A PORTABLE door and window lock that can be carried in the pocket and applied anywhere without nails or screws has recently been invented by B. N. Wickwire, of Carbondale, Pa.

It consists of a wedge that is placed between the door and the door jam.

The wedge carries a series of fine teeth that are brought lightly into contact with the wood by pressure upon a lever. If any one attempts to open the door the movement wedges the lock into the jam and the teeth grip so firmly that the entire doorframe must be torn away, the inventor declares, before the lock can be forced.

Rocks to Give Oil when Wells Run Dry

Mountains of Shale Promise Last Reserve as America's Oil Supply Diminishes

TO OWNERS of 9,500,000 automobiles in the United States the rapid depletion of our oil resources is causing real concern.

The following article, giving assurance of underground reservoirs of the precious liquid still to be tapped, and of shale mountains to be crushed and distilled as a last resort, may serve not merely to allay immediate alarm, but to stimulate greater care in conserving the diminishing supply of wealth from existing wells.

Oil shale formations such as this, in Colorado, are potential sources of billions of gallons of crude oil. Oil is extracted by crushing and distilling the shale

By Ernest Welleck

WHEN the oil wells run dry—then what?

Feverishly draining nature's rich underground stores to provide gasoline for our automobiles and fuel for our engines of industry—consuming each year millions more barrels of oil than we produce—we are suddenly confronted with the statement of the United States Geological Survey that we have used up all but 7,000,000,000 barrels, the entire remaining oil supply in the United States.

At the present rate of consumption, and allowing for an average increase in requirements of about 50,000,000 barrels a year, according to George Otis Smith, director of the Geological Survey, this remaining supply would be exhausted, if imports were barred, in about 20 or 25 years! Even now, the annual volume of our imports of oil, principally from Mexico, is increasing.

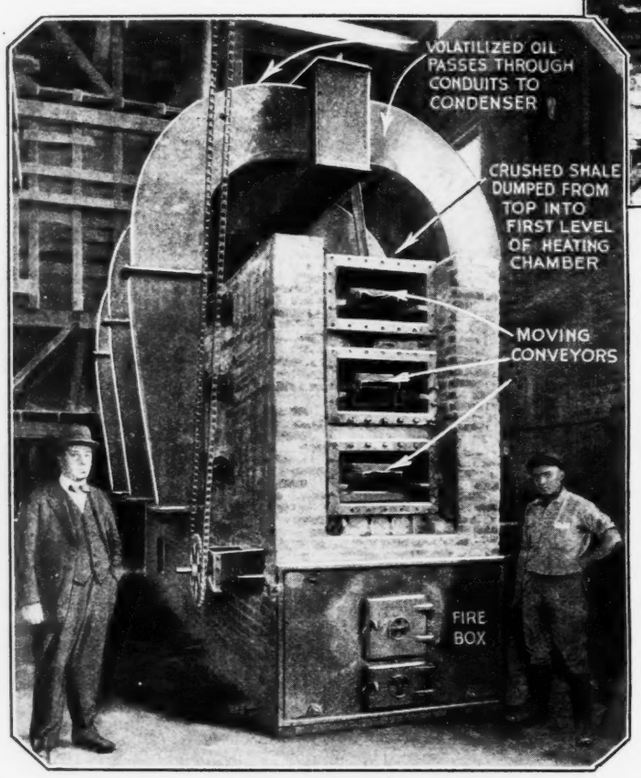
The situation would be alarming indeed, both for the automotive industries and the various industries using petroleum for heating purposes, if they were dependent for their oil supply on the production of the oil wells. But hope for an adequate supply for many years to come lies in recovery of the rich deposits of oil that remain underground, and in immense, untouched beds of oil shale.

Enormous Deposits

After all America's oil wells shall have ceased "gushing" or yielding oil even as modest "dusters" under their own pressure, and even after the large underground deposits shall have been exhausted, there will still remain these enormous deposits of oil shale to draw upon, capable of yielding from 20 to 90 barrels of petroleum a ton, equivalent to from 2 to 9 barrels of gasoline.

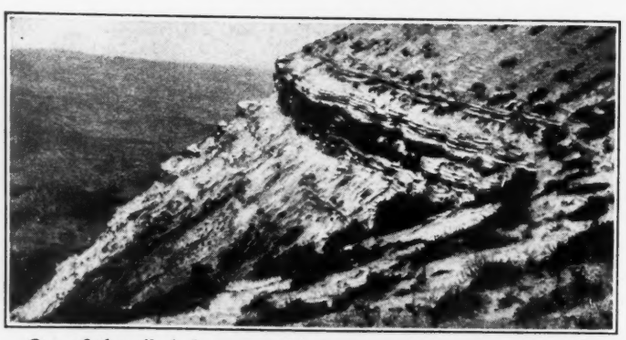
Ingenious methods of extracting the underground deposits after wells have ceased to flow are even now meeting with comparative success. The "mining" of oil shale, however, still remains in an experimental stage; and while the experiments are of tremendous importance from the standpoint of future requirements, it is safe to say that the utilization of the shale deposits on a large scale will begin only when all methods of extracting the underground deposits of crude oil have been exhausted. But that the day will eventually come when our shale deposits must meet our ever increasing demand, is indicated by records of oil production and consumption in the United States.

To date, although less than one sixth of the world's original oil supply was contained in the United States, the 258,000 oil wells of this country have produced a total of about 5,430,000,000 barrels of crude oil, or 62 per cent of the world's aggregate production.


VOLATILIZED OIL PASSES THROUGH CONDUITS TO CONDENSER
CRUSHED SHALE DUMPED FROM TOP INTO FIRST LEVEL OF HEATING CHAMBER
MOVING CONVEYORS
FIRE BOX

How Crushed Shale Gives Up Its Oil

ABOVE is one of the types of retorts or "stills" that have proved successful in extracting crude oil from oil shale, by subjecting the shale to terrific temperatures. The heating chamber is divided into three compartments, one above the other, in each of which runs a moving conveyor. The arrangement of these carriage chambers permits the graduation of heat, ranging from 250° F. in the top chamber to 650° F. or more in the lowest chamber. Crushed shale, dumped into the top level, and carried along by the conveyors, is subjected gradually to increasing heat. Through a system of valves, the vapors are carried from the chambers in conduits and drawn by a vacuum fan to chilling and washing tanks, where they are condensed into oil

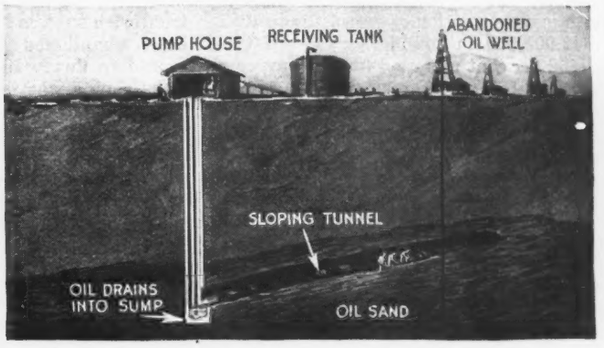


One of the oil shale mountains in the vast deposits covering 5000 square miles in Colorado, Utah, Wyoming, and Nevada

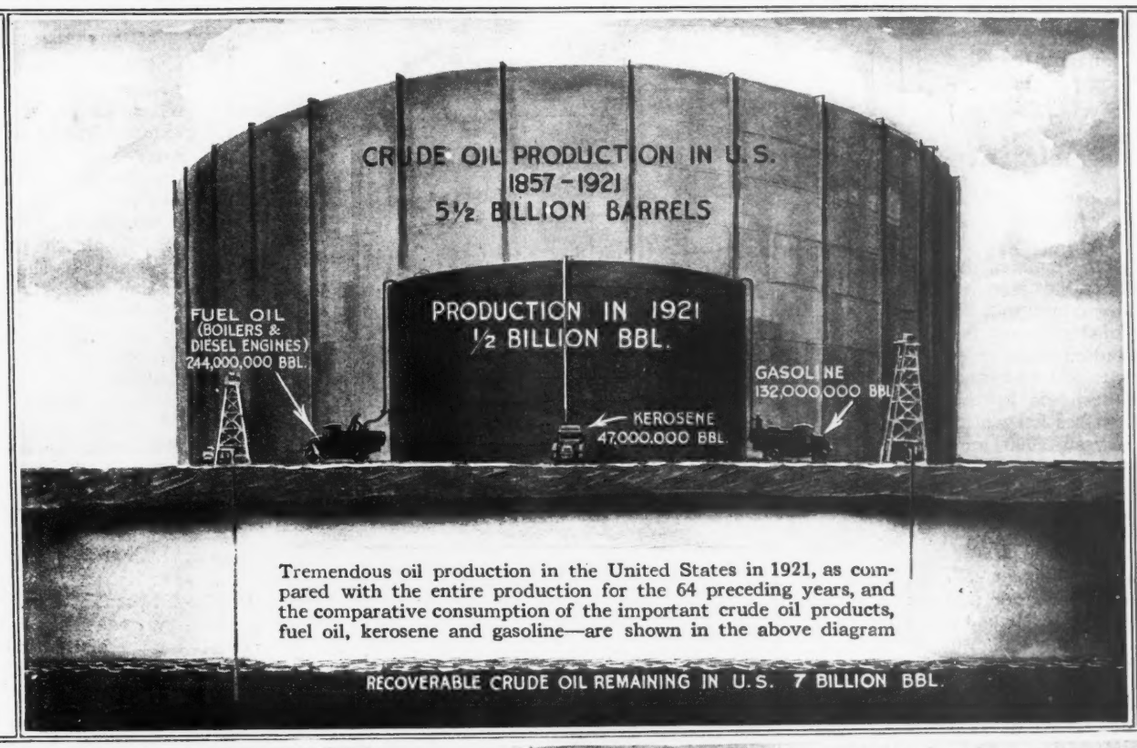
The Production Rate

Continuing the rate of production of the past 65 years, the remaining 7,000,000,000 barrels would not become exhausted for 75 years; yet these figures are deceiving. From 1860 to the present date the production in the United States has more than doubled every 10 years and there is every reason to believe that this tendency will continue to keep pace with the steadily growing demand. The production of crude oil in the United States in 1921 reached 469,639,000 barrels; about 65,000,000 barrels were exported, while the imports, principally from Mex-

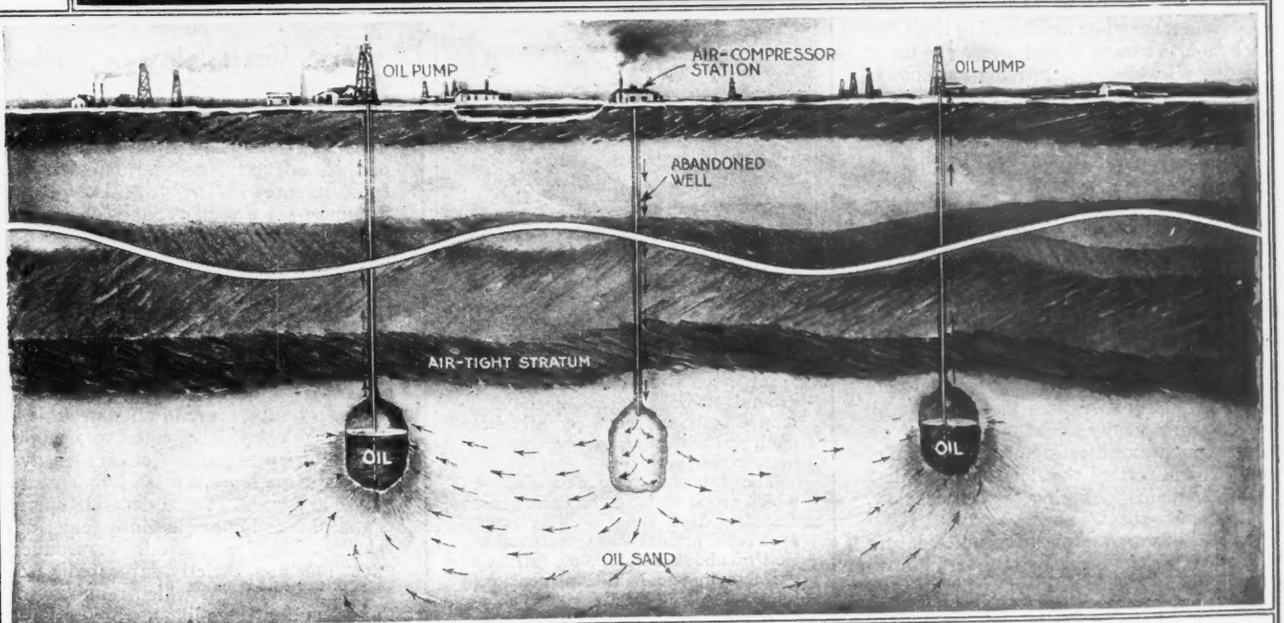
Apparatus for recovering oil from shale deposits is shown above. Mined from the cliffs, the shale is carried in conveyor buckets to a crusher, and then to a distilling retort where it is "cracked" into oils. The residue then passes to a second crusher where it is pulverized for recovery of metals



"Oil mining" as it is being carried on experimentally in Estill County, Kentucky. Sloping tunnels are driven to the oil bearing "sand," a porous limestone which is mined like coal. As this "sand" is broken, some of the oil drains into a sump, from which it is pumped into a tank


CRUDE OIL PRODUCTION IN U.S.
1857-1921
5½ BILLION BARRELS
PRODUCTION IN 1921
½ BILLION BBL.
FUEL OIL (BOILERS & DIESEL ENGINES) 244,000,000 BBL.
KEROSENE 47,000,000 BBL.
GASOLINE 132,000,000 BBL.
RECOVERABLE CRUDE OIL REMAINING IN U.S. 7 BILLION BBL.

Tremendous oil production in the United States in 1921, as compared with the entire production for the 64 preceding years, and the comparative consumption of the important crude oil products, fuel oil, kerosene and gasoline—are shown in the above diagram



Compressed air is being used successfully, as shown above, to recover oil in districts where wells have run dry. Air under heavy pressure, forced into one of the abandoned wells, pushes the oil through the sand, away from the well. This migrating oil eventually reaches neighboring wells which slowly fill and become productive once more

ico, reached double that figure, about 137,000,000 barrels, thus bringing the total domestic consumption of petroleum in 1921 to 542,000,000 in round figures. Of this total, 52 per cent was used for fuel purposes under boilers or in Diesel engines, 28 per cent in the form of gasoline for automobiles, auto trucks, gasoline launches and gasoline engines in general; 10 per cent was used for lighting purposes in the form of kerosene, 5 per cent for lubricating oils and 5 per cent for miscellaneous purposes.

Consumers of fuel oil and gasoline are obviously those most vitally interested in the future of the oil supply. Twenty-five years ago there were but four motor vehicles in the United States; today their number is nearly 9,500,000, with the promise of a steady increase every succeeding year. According to the most careful estimates, the average annual gasoline consumption per motor vehicle is about 450 gallons.

Mountains of Shale

Oil shale deposits, which seem to offer future guarantee against an acute shortage, are so enormous in the United States that they insure an adequate supply for the needs of this country for several hundred years.

One of the largest and richest deposits is in the Green River section which covers between 5000 and 6000 square miles in Colorado, Utah, Wyoming and Nevada. The possible yield from these mountains of oil shale is estimated at from 200,000,000,000 to more than 300,000,000,000 barrels of oil. The shales of Colorado alone promise to yield more than 58,000,000,000 barrels, or about 6½ times the quantity of oil produced in the whole world from 1857 to the present day.

With the mountains of shale to fall back on as a final, although expensive, reserve, engineers meanwhile are devoting their first attention to means of prolonging the life of existing oil wells by improving methods of blasting, pumping and the use of compressed air.

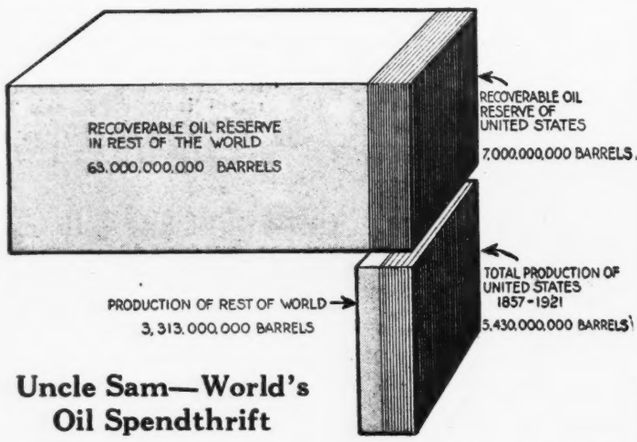
When Oil Ceases to Flow

Oil experts have estimated that not more than 25 per cent of the oil, even in the richest deposits, ever reach the pipe lines. Fully 75 per cent remains underground because the gas pressure is not strong enough to push the oil toward the well and to the surface. Consequently, when an oil well ceases to flow under its own gas pressure, artificial means of extracting the liquid are necessary. In some cases the life of an oil well is prolonged by allowing it to rest for a time; sometimes blasting at the bottom of the well will restore the flow, and, as a last resort, remains pumping, which is slow, tedious and expensive.

In Estill County, Kentucky, and Ventura County, Calif., where the oil-bearing stratum is within 150 or 200 feet of the surface, tunnels have been driven through the overlying unpermeable shale to the oil bearing "sand," which is now being mined like coal. The "sand," which in some cases contains as much as 25 per cent by volume of crude oil, averages about six to 10 gallons a ton.

Recently another new method has been tried with success in oil districts which had been abandoned because the well had ceased to flow. In one of the abandoned wells a pipe was inserted through the air-tight cap of the well tube. Through this pipe air was forced under heavy pressure into the well. The compressed air took the place of the natural gas that had formerly forced the oil to the surface, and with irresistible force pushed the oil through the sand, away from the source of the pressure. The result was that the migrating oil eventually reached neighboring wells, which thereby became productive again.

When, at last, restoration methods such as these shall have drained the wells until production faces a standstill, then the time will have arrived for attacking the problem of producing oil from shale. If the oil were contained in the pores of the shale, as it is in oil "sand" and in the pores of porous rocks, production of oil from shale would be a simple mining problem. Oil shale, however, contains no oil at all, but various decomposition products of fossil organic matter which, when subjected to destructive distillation, yield first a heavy solid or semi-solid bitumen.


RECOVERABLE OIL RESERVE IN REST OF THE WORLD
63,000,000,000 BARRELS
RECOVERABLE OIL RESERVE OF UNITED STATES
7,000,000,000 BARRELS
PRODUCTION OF REST OF WORLD
3,313,000,000 BARRELS
TOTAL PRODUCTION OF UNITED STATES 1857-1921
5,430,000,000 BARRELS

Uncle Sam—World's Oil Spendthrift

IN spending his oil resources for industrial expansion, Uncle Sam has been lavish, compared with the rest of the world. Sixty-five years ago the United States held less than one sixth of the world's oil supply; yet in those 65 years, oil wells in this country have produced 62 per cent of the world's total production. As a result, the recoverable oil reserve of the United States today is only one ninth of the reserve of the rest of the world.

The "Cracking" Process

As the distillation continues, this bitumen is vaporized and "cracked" into a large variety of petroleum-like oils, including light and heavy oils and gasoline, paraffin and a series of by-products. The result depends upon the character of the shale, the preliminary treatment of the rock, the method of distillation and the temperatures to which the shale is exposed during the process. The Colorado shale, for example, yields products similar in constitution to a mixed base petroleum oil such as is found in the Mid-continent field; the Canadian shale is more like an asphaltic base oil, such as California crude, and contains but little paraffin; the Nevada shale, on the other hand, contains a large percentage of solid paraffin wax.

The preliminary treatment of the shale, in preparing it for the distillation process, merely involves the crushing of the shale to fragments, about ¼ in. or less in diameter, which are fed into retorts and subjected to high temperature.

Three Successful Shale Methods

The three most promising methods so far successfully tried on a large scale for "cracking" the heavy bituminous product of the destructive distillation of shale, are those invented by Dr. W. M. Burton, of the Standard Oil Company, and Doctors Rittman and McAfee during their researches at Columbia University. In the Burton process the "cracking" takes place under a continuous pressure of about 75 pounds, at an average temperature of about 700 degrees F. In the Rittman process the "cracking" is carried out in the vapor stage by passing the vapors under a pressure of 300 pounds and at a temperature of about 700 degrees F. through externally heated vertical pipes.

The third process, that of McAfee, avoids the use of pressure, uses a temperature of only 500 degrees F. and depends upon the chemical reaction of aluminum chloride for the "cracking" of the oil. It produces a sweet smelling, strictly saturated gasoline of low boiling point which requires no refining, and a coke-like carbon easily removed. The process is more costly than the other two, because no economical method has been evolved for recovering the aluminum chloride used in the process.

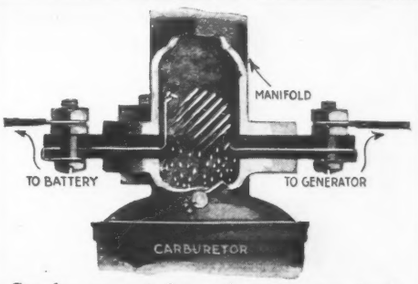
Stopping a Leak

TO prevent evaporation of crude oil—the cause of one of the largest single losses to which the oil is subjected after it is taken from the ground—storage tanks in the Panama Canal zone have recently been equipped with metal protective awnings, as shown above.

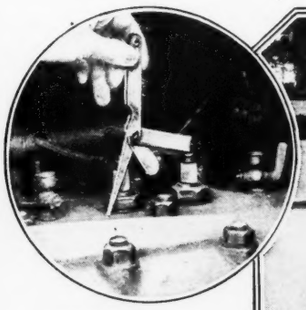
The interval of a few days in which crude oil is stored before being transferred to the pipe line results in a total annual loss from evaporation of about 122,100,000 gallons of gasoline in the Mid-Continent field alone. At 22 cents a gallon, this is a money loss of $26,862,000, and represents about three per cent of the total gasoline produced in the United States.

Safety Fender Sets Brakes and Stops Car at First Impact

The Month's News of Ingenious Automobile Accessories, Useful to Every Car Owner, Told in Photographs

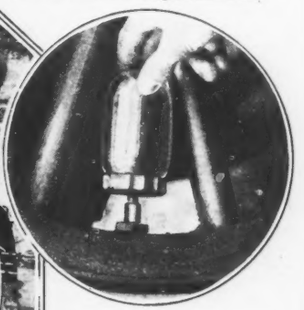


Surplus current from the generator heats the resistance coil between carburetor and manifold and insures vaporization

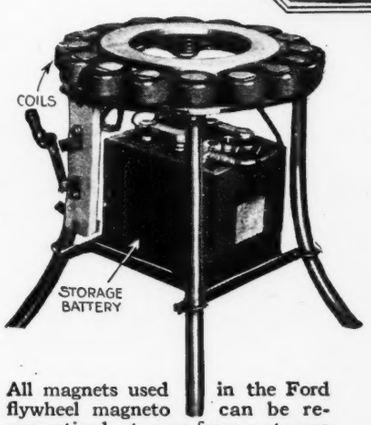


This handy vest-pocket tool contains three folding blades which are shown as used for spark-testing. They are useful also for other purposes around an automobile

The instant the resilient bars of this safety fender strike a person or object, electrically controlled mechanism cuts the ignition and sets the emergency brake

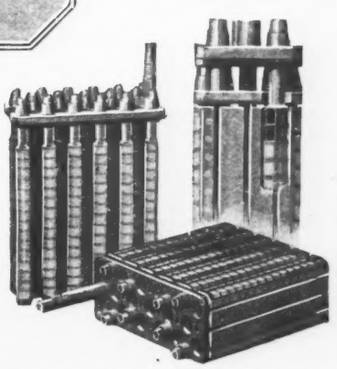


This little pressure tank contains enough carbon dioxid gas to inflate the average tire to 60 pounds pressure. The compressed gas may also be used for putting out fires

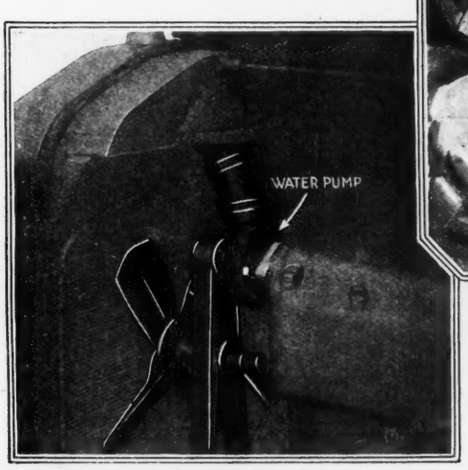


All magnets used in the Ford flywheel magneto can be remagnetized at once from a storage battery by this series of coils

A thin, stiff piece of steel with handle attached, forms a handy tool for removing tires



Resembling pencils in size and shape, 17 positive elements in this new type of storage battery are bolted to a top plate. These pencils fit into corresponding holes in the negative element

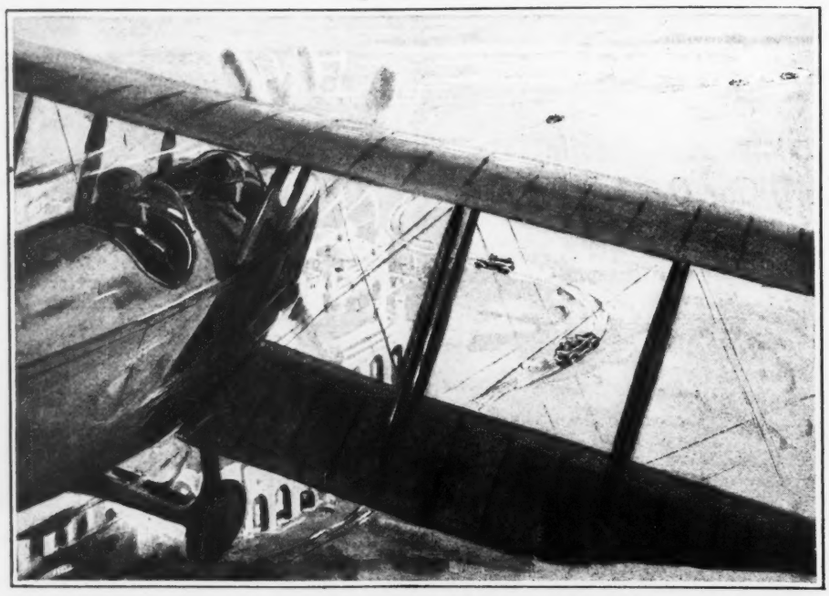


This new water pump for Ford cars is driven by an extra belt placed over the fan belt from the driving pulley

The editor will be glad to supply names and addresses of manufacturers of devices mentioned in this issue

A convenient dimmer switch consists of an aluminum arm attached to the steering wheel within easy reach of the thumb

Autos Blaze Airplane Trail in Desert



IF AN airplane crashes or is forced to land in a trackless desert, how may its pilot send news of his plight to the outside world, or how can rescuing parties locate him?

That flying above desert solitudes might be made safe for a proposed transarabia airplane flight, nine British military automobiles recently blazed a trail across the Syrian desert. This was done by playing "follow the leader," with each automobile making still deeper the ruts left in the sand by the car ahead.

The airplanes followed this trail. When an engine "died" or a plane was otherwise disabled, the pilot reported his accident by wireless as he glided to the ground. Rescuing parties immediately set out and, by keeping to the trail blazed in the hard sand, had little difficulty in finding a pilot should he happen to be in trouble.

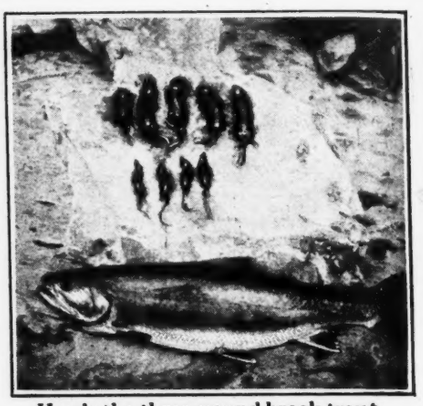
After many experiments, it was found that the track made by the automobile wheels in the sand served the purpose well. Over stretches of rocky lava country, however, the path was also marked by craters formed by exploding large bombs.

The trail-blazing party made an accurate survey along the route. This, by the way, was accomplished largely by the aid of wireless broadcasts. Each night the surveyors determined their position by the stars, and to do this an exact knowledge of the time was necessary. A small portable wireless set, erected in the desert, received the time-tick sent out from the Eiffel Tower in Paris, 2000 miles away.

AS a special service to readers, the Editor will be glad to supply the names and addresses of manufacturers of devices mentioned in this magazine.

Nine Mice Make a Meal for Hungry Trout

HOW did a three-pound brook trout come to swallow nine fieldmice for one meal? When the fish was caught in John's River, Canada, by J. E. Barbour, of Paterson, N. J., nine mice were taken from its stomach. How did this trout overtake the mice simultaneously?

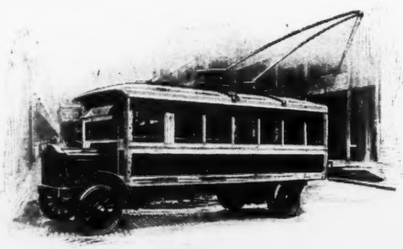


Here's the three-pound brook trout with its meal of nine mice

For an answer, Mr. Barbour suggests that the mice started to swim across the stream, and, overwhelmed by the swift current, were swept into the pool where the big trout was lurking.

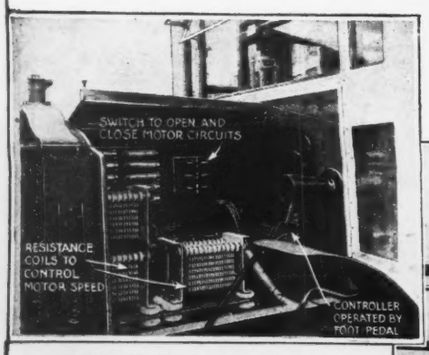
Electric Motors Convert "Gas" Bus into Trackless Trolley

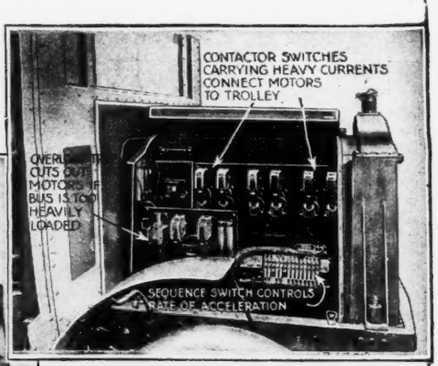
GASOLINE motor-buses are being converted into electric "trackless trolleys," replacing the gas engine with electric motors and control. This new type of vehicle is expected to find its chief use on suburban routes where trolley wires are in place, but where traffic is too infrequent for regular trolley-car schedules

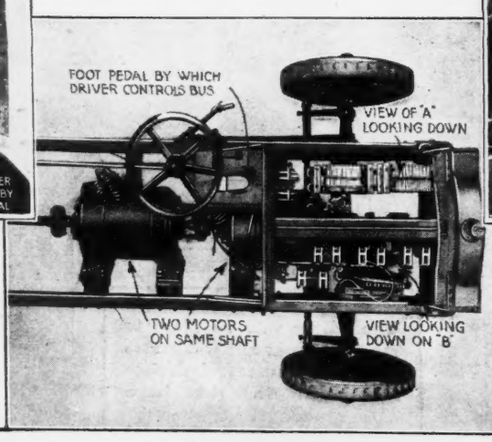


A special trolley-pole allows the bus to round corners or run close to curb

CURRENT is taken from a two-wire trolley system. In crowded traffic the speed of the bus can be held at any point by means of notches on the control pedal. For sudden grades and heavy load conditions, the driver can give the bus unusual acceleration by increasing the speed of a small regulating motor any desired amount




CONTACTOR SWITCHES CARRYING HEAVY CURRENTS CONNECT MOTORS TO TROLLEY
SEQUENCE SWITCH CONTROLS RATE OF ACCELERATION



COILS UNDER THE HOOD

Under the left side of the hood are resistance coils and switches, as shown in illustration *A*. Arrangement of two street-car motors in tandem and of the units under the hood are pictured at the right. The control is by pedal

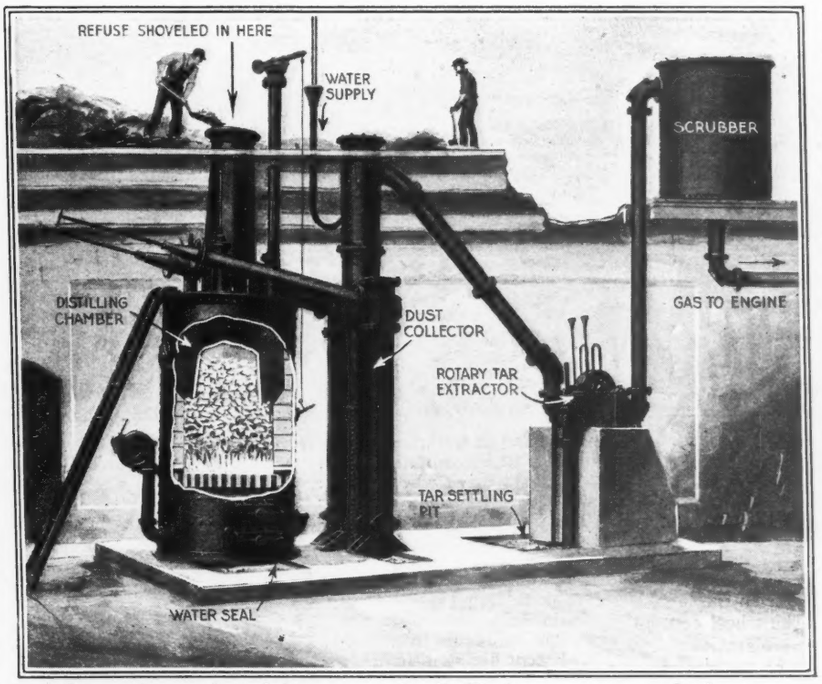
SWITCH CONTROLS CURRENT

The current is controlled by a revolving sequence switch under the right side of the hood, as in illustration *B*. The speed of the revolving switch depends entirely upon the speed of the motor, permitting gradual acceleration

Gas Plant Turns Refuse into Power, Light and Heat

ON FARMS or in manufacturing plants, waste of vegetable origin, like wood chips, sawdust, bark, nut shells, fruit stones, sugar cane and cotton seed may be turned into profit by a miniature gas plant of great simplicity in which refuse is distilled to yield heat, gas for lighting or heating, tar and other valuable by-products.

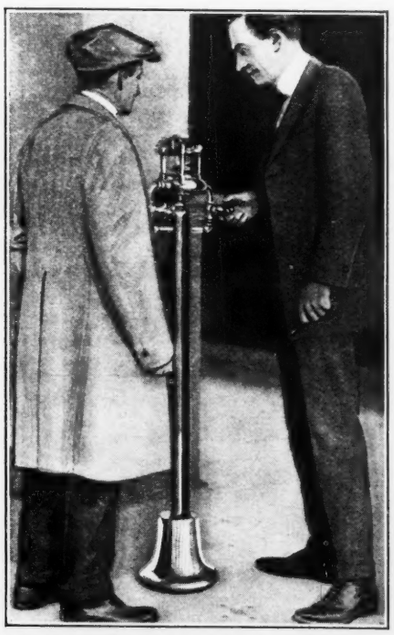
In the producer plant, the waste is stored on a platform on the same level as the opening through which the generator is charged, and is thrown into the feeding shaft which leads to the distilling chamber. There it is subjected to destructive distillation, releasing gas, tar and ashes which are carried along by the draft.



Gas and tar released from waste by distillation are separated, the gas passing to a scrubber, where it is purified, then into distribution pipes

These products are conducted through a dust-collector and a washer to a two-stage centrifugal separator, which removes the tar and allows the gas to pass to the scrubber, where it is freed from any remaining impurities. The gas may then be conducted to a storage tank or fed direct to the pipe system which carries it to the places where it is used for heating or illuminating, or for generating power.

One manufacturing plant, utilizing waste sawdust and shavings, reports that the gas plant has wiped out the company's fuel bill.



Puzzled Consumers Learn How Meter Works

REALIZING that the consumers of measured service are inclined to doubt the correctness of their bills, especially when they are unfamiliar with the mechanism of the meter, the municipal water department of Los Angeles, Calif., has placed a demonstration water meter in the lobby of its office.

The mechanism of the meter is incased in glass so that the workings of all parts can be observed, including the registering gears turning the indicators of the dials. Two nickel-plated pipes connect the meter with the service pipes of the municipal water supply system.

Tiny Field Mouse Builds Its Nest Skilfully

THE dwarf mouse can give the birds a few pointers on how to build nests. Among the reeds this little animal skilfully fashions the home that two or three times a year shelters a litter of five or six mice.

The full grown rodent is only a trifle more than two inches long, reddish brown on the back, yellowish on the sides, and white on the under side.

It builds its nest of swamp grass and stalks of reed, shredded into long fibers by its sharp teeth. The fibers are skilfully woven into a spherical basket, open at the top, lined with thistledown and silky fibers from the seed pods of other weeds.

The nest is merely the summer home of the mouse, where it rears its young.

Shredding reeds into long fibers, the mouse skilfully weaves its nest

"Best Sellers" to Be Sold by Slot Machines

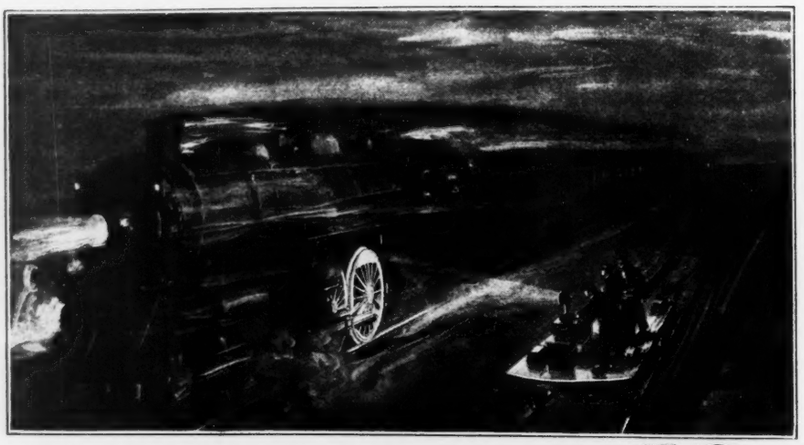
SLOT machines for books are shortly to make their appearance in restaurants, railroad terminals and stores. Each machine holds twelve books displayed behind a glass front.

To operate the device, the purchaser notes the number on the book he wants and adjusts a handle at one side to produce that number. A coin inserted in the slot, accompanied by a slight pull on a loop, releases the book, which drops into a trough at the base of the machine.

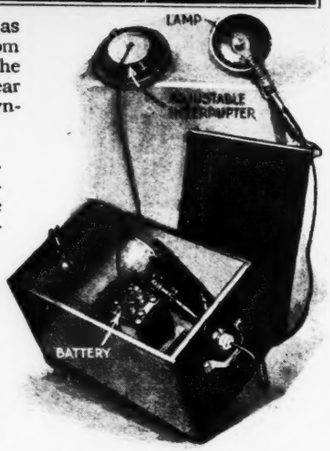
Spurts of Light Analyze Machinery's Motion

MOVEMENTS of high speed machinery, too rapid for the eye to detect, can be slowed down for study and analysis by means of an ingenious new mechanism known as an oscilloscope which, strangely enough, makes use of a peculiar, sluggish property of the eye called "persistence of vision."

By means of the new device, the working of individual parts of the mechanism can be easily discerned, and erratic or abnormal action detected and remedied. The drive wheel of a locomotive speeding a mile a minute, for example, could be studied by observers on a speed car equipped with the device and traveling neck and neck with the locomotive. To the observers the wheel could be made to appear as if it were stationary.



To observers on a car traveling at the same rate as an express train, the intermittent illumination from the oscilloscope, focused on a drive wheel of the speeding locomotive, would make the wheel appear as if standing still. The device is geared to synchronize with the revolutions of the wheel



By means of the adjustable interrupter, the electric bulb shown at the right produces intermittent flashes of light

The oscilloscope consists of an electric gear box which makes and breaks contacts supplying energy to a series of electric bulbs. The gear box is connected with the moving part of a machine while the bulbs are used to illuminate the same part at desired intervals. To fully grasp its operation, consider the case of an ordinary wagon wheel. If the wheel, in rapid motion, is viewed by the unaided eye, the spokes appear as a solid disk; but if it were possible to open and shut the eyes at certain regular intervals based on the angular movement of the wheel, the spokes would appear to be standing still. This is due to the fact that the eye would perceive the spokes only when they occupied one position during each complete revolution, but would not see the movement while they were changing positions.

But now, if the eyes are opened and shut a short time later, the spokes, instead of appearing stationary, will seem to move slowly because, as they are viewed each time, they will have moved forward slightly from their previous position. But on account of the sluggishness of the eye in giving up any image thrown upon the optic nerve, two or three of the positions of the spokes will be present on the brain simultaneously. Consequently, the spokes appear to move slowly in a progressive cycle at a speed depending on the rate of opening and closing of the eyes.

Figuratively speaking, the oscilloscope performs this winking operation for the eyes. When it is used, the experiment is usually conducted in a darkened room where the object being analyzed is brilliantly illuminated at stated intervals by the bulbs controlled through the gear box attached to the object.

Suppose that it is desired to study the movement of a flywheel rotating at 1000 revolutions a minute. The gear box is attached to the hub of the wheel and allowed to rotate with it. If the contacts are adjusted so that the electric bulbs are lighted once every revolution, the wheel will seem to stand still. Then, if the gears are changed so that the wheel is lighted by a flash at every revolution and a tenth, the spokes will appear to move forward slowly.

In actual practice a gear ratio of 100 to 1 is found most suitable. A wheel revolving 1000 times a minute would appear to be revolving but 10 times a minute.

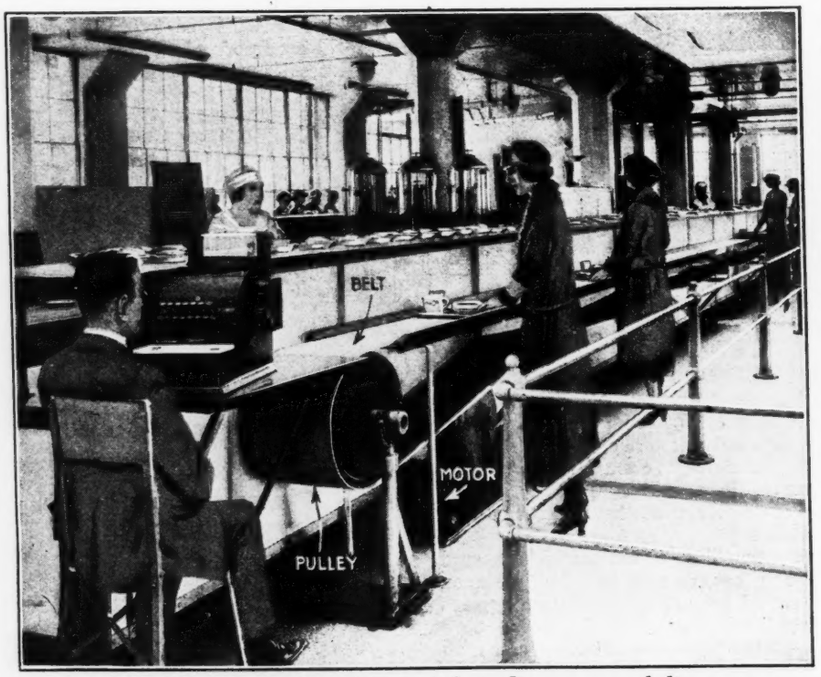
Tray Conveyor for Cafeteria Keeps the Line Moving

CONSTANTLY moving conveyor belts in the employees' cafeteria of a great optical goods manufacturing plant at Rochester, N. Y., make the service quick enough to suit the most impatient. A belt runs along the front of each counter, and moves at the speed of a loitering walk. It is driven by a small electric motor under the counter. The patron places a tray upon the belt, and walks along beside it, selecting his luncheon as the tray passes the dishes stacked upon the counter.

The effect is to keep the lines moving at a uniform rate, and to prevent a person from hesitating over a selection and impeding those behind. It is possible, of course, to hold back the tray with one hand, but experience with the conveyor has shown that very few people do so.

The quick service reduces the amount of help and floor space required for the lunchroom, and enables the company to serve an attractive meal at a price lower than obtainable outside the factory.

The editor will be glad to supply the names and addresses of manufacturers of devices mentioned in this issue of POPULAR SCIENCE MONTHLY

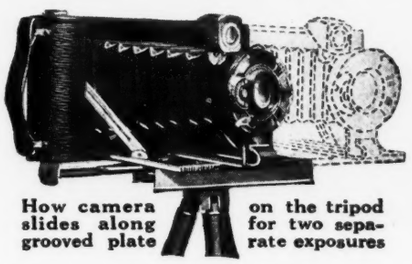


If the diner hesitates too long, his tray is lost. It moves on a belt conveyor to prevent his holding up the procession

Kodak Adapted to Take Stereoscopic Views

STEREOSCOPIC pictures made with a single camera and lens are now possible through an adapter conceived by William Prucha, of San Diego, Calif. The device consists of a grooved plate, which is attached to the tripod under the camera, allowing the latter to slide back and forth between certain points. The distance between the points is the same as that between the eyes.

In making stereoscopic negatives, the camera is slid to one side of the adapter for



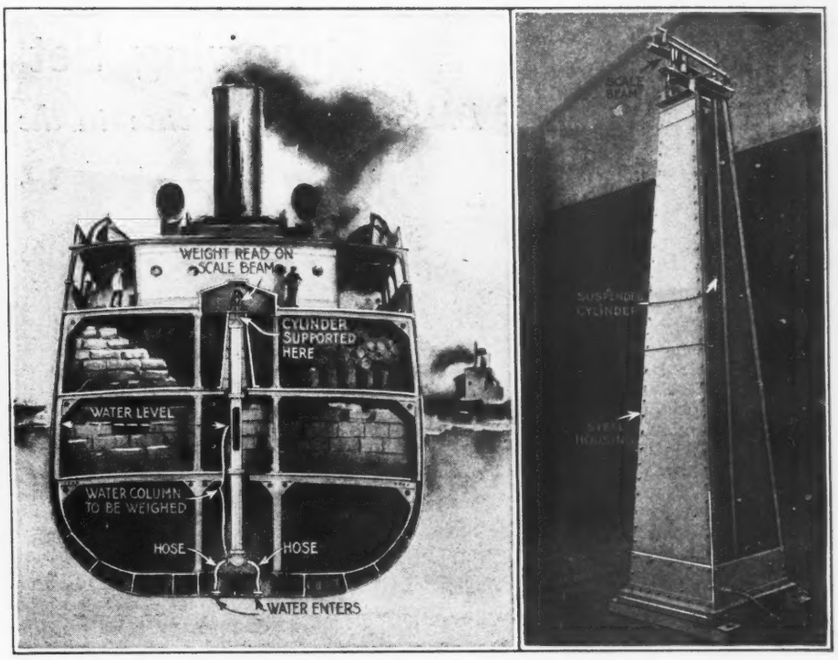
How camera slides along grooved plate on the tripod for two separate exposures

an exposure. The film is then turned and the camera moved to the opposite side, where the second exposure is made. Prints made of these two negatives and mounted side by side on a card will give a true plastic appearance through a stereoscope.

Negatives from two exposures are mounted side by side for the stereoscope, as shown above

BECAUSE chica nuts, used in making charcoal for gas masks, are protected by shells that withstand a pressure of 1800 pounds, the United States Bureau of Standards has recently used liquid air to cool the nuts before cracking them with a sledge hammer.

Water Column Weighs Cargo in Ship's Hold



The upper end of the encased tube, shown at the right, is hung on a weighing beam. Water enters the lower end through flexible tubes

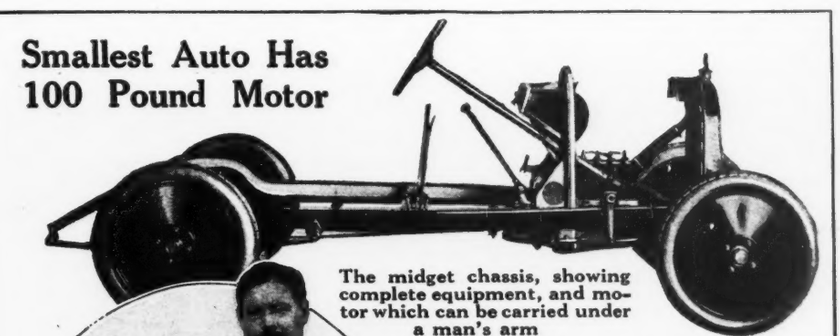
WEIGHT of the cargo in the hold of a ship can now be determined in a minute or two and to within 110 pounds by means of an ingenious tube in which the increasing weight of rising water measures the increased displacement of a vessel due to added tonnage.

The tube, invented by M. Angereau, a French engineer, is suspended in a vertical position through the center of the ship and protected by a shaft of riveted steel plates. The top end of the tube is attached to one end of a weighing beam which is pivoted on a bearing supported by the upper part of the steel shaft structure. Flexible tubes extending from the lower end lead to the water at the keel of the vessel.

The greater the load of the cargo and the consequent increased displacement of the vessel, the higher the water rises in the tube and the greater its weight. The proportion between the weight of the water in the tube and the weight of the maximum cargo is established beforehand for each craft. As the ratio does not vary in the same ship, the weight of the water in the tube at any time automatically gives the proportionate weight of the cargo. The balance arm is calibrated to indicate the weight of the load in pounds and in some cases is provided with a mechanism for printing the figures on a record tape.

When the fully loaded ship is ready to sail, the weighing apparatus is blocked to prevent damage.

Smallest Auto Has 100 Pound Motor

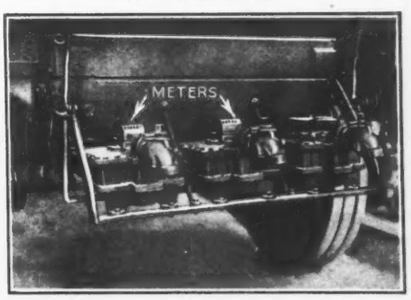


The midget chassis, showing complete equipment, and motor which can be carried under a man's arm

THE world's smallest factory-made automobile, built in France, is so small that the entire power plant, consisting of four cylinders, magneto and flywheel, can be held in one arm. The total weight of the motor is only 100 pounds.

The cylinders have a bore of only 2.17 inches and a stroke of 3.35 inches.

With the eight horsepower motor, the automobile will run more than 50 miles on a gallon of fuel. Although all parts are in miniature, none is omitted. Starting and lighting equipment is complete.



Metered Faucets Check Up Delivery of Gas

TO eliminate waste and thievery by the drivers of tanks which deliver oil or gasoline to customers, a Western oil concern has equipped the discharge faucets of its delivery wagons with meters which not only measure each gallon or fraction of a gallon drawn from the tank, but record it, like a cash register.

The old system under which everything depended upon the honesty and efficiency of the driver, had often given cause for dissatisfaction and entailed considerable loss to the company. The experiment is being watched with interest by other concerns and it is believed that before long many tank trucks in the United States will be equipped with similar meters.

Lamp Hides Powerful Radio Receiving Set

Photo News of Science in the Home

This electric beater or mixer, attached to any light socket, may either be held in the hand or rested on a support supplied with it

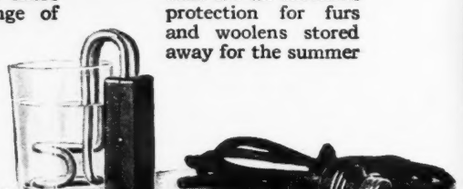
When the pump of this siphon is inserted above the cream line in a milk bottle, one pull on the handle draws off all the cream

Hidden under the shade of this lamp is a complete radio receiving outfit, while the cone shaped base, which stands on three short legs, acts as a loud speaker. The set has a receiving range of several hundred miles

Gold, silver or plate, placed in contact with this electrolytic cleaning plate and covered with hot soda solution, are quickly freed from tarnish

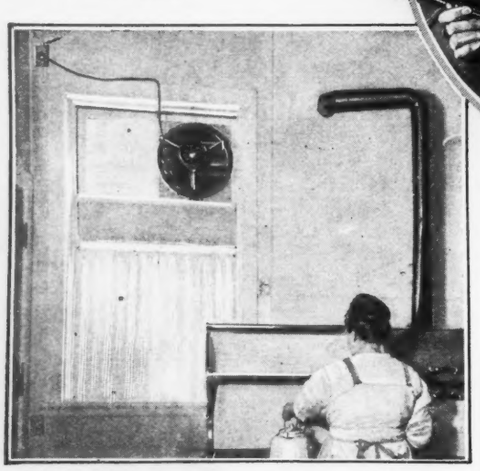
Little bags of gingham filled with moth balls are an excellent protection for furs and woolens stored away for the summer

For thoroughly cleaning milk bottles, this brush with a stiff tuft of bristles at the tip of a cylindrical scourer reaches otherwise inaccessible parts



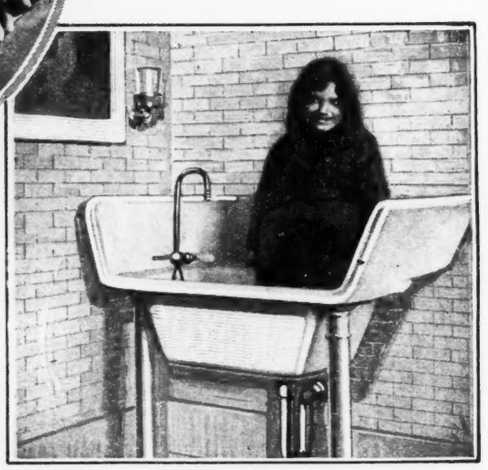
For heating the liquid contents of a tumbler or other small container a small electric heater has been placed in the market. It can be connected with any electric light circuit

The rod of this umbrella has a hinged joint, which makes it possible to fold the umbrella for packing into a parcel only 18 inches long



Odors from kitchen or laundry can be prevented from permeating the whole house, if an electric ventilator is placed in the window as shown above

The editor will be glad to supply the names and addresses of manufacturers of devices mentioned in this issue of *Popular Science Monthly.*



This combination bath tub, foot bath and wash tub was recently invented for use in apartments of small dimensions, where it serves many needs of the home

Why Automobile Engines Wear Out

Crankcase Oil Dilution, Chief Cause of Power Loss, May Be Conquered by Newest Methods of Lubrication

By Harold F. Blanchard

CRANKCASE oil dilution is one of the greatest worries on the national motoring mind today. Automobile engines are fundamentally designed to operate on dry gasoline vapor. This was easily possible in bygone years when gasoline vaporized readily. But since that time the automobile industry has turned out so many million motor vehicles that the oil producers have had to resort to "cracked oil" to supply enough liquid fuel to meet this enormous need.

Many Products from Crude Oil

In crude oil there is only a very small percentage of true gasoline. Crude oil is a mixture of a great number of oils all belonging to the same family but varying gradually in volatility from the very light oils, which are gases at ordinary temperatures, to the very heavy oils which are almost solid. In a group of light oils near the top of this scale is the old fashioned high test gasoline. Right below it in volatility is another group of oils called kerosene, of which a considerable proportion must be mixed with the "gasoline" oils in order to eke out the failing supply. The still heavier portions of the crude are "cracked" by various special processes in which high temperatures are used for breaking the heavy oils into lighter ones.

But the cracked oils that are thus made available for motor fuel unfortunately are not nearly so volatile as old time gasoline and many of them are more like kerosene. The result is that modern gasoline vaporizes with difficulty, and consequently considerable raw or liquid gasoline is carried over into the cylinders, where some of it leaks down the cylinder walls past the pistons and is absorbed by the oil in the crankcase, diluting the lubricant. Nothing is worse than kerosene for destroying the body of a lubricant.

Recent tests revealed that various cars showed a dilution of from 15 to 41 per cent after only 100 miles of running, the dilution in one case increasing to 87 per cent after running 563 miles in a single month. Crankcase dilution causes rapid wear and serious loss of power due to excess friction. Pistons become loose before their time, rings need replacement and cylinders require reboring with ever increasing frequency and the life of engine bearings and other parts is greatly shortened.

Equally serious is the fact that an engine operating on diluted oil fails to develop full power. The loss, revealed by actual tests, may be as much as five or 10 horsepower, due to excessive engine friction caused by the inability of the thinned oil to keep the wearing surfaces apart. Friction absorbs a tremendous amount of power in even a well lubricated engine operating on undiluted oil, as every motorist who has used his engine as a brake knows. In low gear the engine, with switch off, exerts an extremely powerful retarding action and will hold the speed of the car down to about 10 miles an hour on even the steepest hills. This braking effect is not due to the engine compression, as many believe, but to engine friction—a fact that has long been recognized by automotive engineers.

Loss May Be Ten Horsepower

Since friction is tremendous, even in a well lubricated engine, it is not hard to realize that an engine operating on diluted oil may readily show a loss of five or 10 horsepower. This loss increases the fuel consumption to such an extent that an engine which should give 18 miles on a gallon of gasoline may not give more than 15 miles or even 12 miles.

Oil dilution explains why some engines

Veteran Garage-Man Builds Wearproof Car

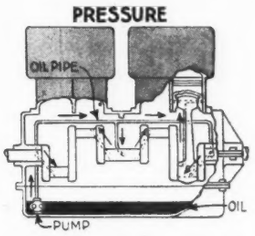
MOST eloquent testimony of the importance of continuous and adequate motor lubrication is offered by a certain automotive engineer who, while conducting a large repair shop for several years, kept a detailed record of repairs on 10,000 cars as they passed through his shop.

Tracing the cause of motor trouble, in nearly every case, to defective lubrication, this engineer set out to build a perfectly lubricated car that would wear practically forever. That was several years ago. Since then he has turned out a few cars each year at Newark, N. J., and they invariably run 50,000 miles with no attention beyond carbon removal and brake adjustment. Outside of putting lubricant in the engine, lubrication duties in this almost frictionless car are limited to filling 10 different points on the chassis once every six months Most of the parts, including the clutch transmission, drive shaft, rear axle and springs, are automatically lubricated from the engine and need no attention.

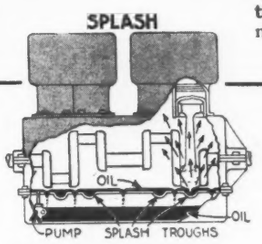
THE fact that the car costs him $10,000 to build—chassis alone—measures the tremendous importance of lubrication. At the same time, the car has proved that perfect lubrication and extreme simplicity go hand in hand.

A properly lubricated engine will wear forever. Engines are wearproof until the oil film breaks. On some parts the oil film may be broken from the moment the engine is put into use, while on others, it may be years before the oil film is broken. There are cases where engine bearings have been run for years, for distances of from 75,000 to 100,000 miles, without appreciable wear, simply because the oil film was continuously maintained during this period.

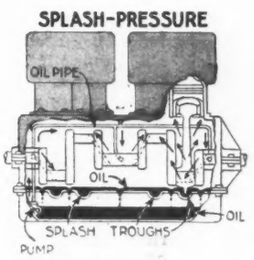
Three Methods of Lubrication



The above diagram of the pressure system shows how a pump forces oil into parts requiring lubrication



In the splash system, oil in troughs is splashed up into the parts by the connecting rods



The splash system may be supplemented by pressure lubrication, as shown at the right

Oil Dilution—the Arch Enemy of Power

The worst "jinx" a car can have is engine oil dilution, which, in a 3000-pound automobile traveling 25 miles an hour, brings the power loss in the engine to 10 horsepower—twice as great a loss as that caused by running gear friction—including friction in transmission, axles, and tires—and five times greater than the loss from wind resistance. Diluted oil increases engine friction and fuel bills

AMERICA'S diminishing oil supply, coupled with the ever increasing demands of the automobile industry, is the chief cause of crankcase oil dilution, as Mr. Blanchard points out in the accompanying article. Read, on page 56, a startling revelation of how the United States is exhausting its immediate oil resources, and a description of methods by which they will be replenished.

run so sweetly some days and so poorly on others. An engine not only develops less power on diluted oil but it is noisier, because the rubbing surfaces which would be kept apart by undiluted oil, scrape and clatter. Putting in fresh, clean engine oil will often make a surprising difference in speed or hill-climbing ability.

For cars now in use, the obvious remedy for dilution is to change the engine oil frequently. New oil should be supplied every 500 miles. It is a mistake to run 1000 or 2000 miles or more with the same oil. Loss of power, increased fuel consumption and greatly accelerated wear must inevitably result. Engines equipped amply to heat the intake from the exhaust, suffer less from dilution because the heat vaporizes a large portion of the heavy elements in the fuel; yet the drawback here is a reduction in maximum power if the charge is thoroughly warmed at all speeds.

The Rate of Dilution

In recent tests the dilution in a certain medium priced car after a run of 300 miles was 14 per cent. Another medium priced car showed oil dilution of 10 per cent in only 231 miles, while a third machine showed 47 per cent dilution after 563 miles. In a high priced machine, dilution was 22 per cent after 214 miles.

In cold weather, dilution will take place more rapidly than in warm weather. Certain farm tractors, when tested, showed a dilution of from 10 to 30 per cent in a week in warm weather and from 20 to 50 per cent in cold weather. The same machines operating on kerosene instead of gasoline, showed dilutions of from 30 to 70 per cent.

Motorists who are worried about crankcase dilution have almost invariably attempted to offset the trouble by using heavier oils, on the theory that if fuel leakage from the cylinders makes the oil too thin after a few hundred miles, then it is logical to start with a thick oil. This practice is a mistake. The heavy oil greatly increases engine friction, and even when it becomes diluted to the consistency of a light oil, its lubricating quality is not the same. The most serious drawback in using a heavy oil is that carbon forming ability is directly proportional to the thickness of the oil. Recent tests revealed that a medium oil caused the formation of carbon three times as fast as a light oil.

From a standpoint of minimizing both friction and carbon, the light oil is preferable, but it must be changed very frequently. The man who is careless or forgetful about drawing off the diluted oil and replacing it with fresh, will be better off with a medium oil.

Another reason, besides dilution, why oil should be changed frequently, is the fact that bearings are scored by dirt that gets into the oil and stays there. The only way to keep the oil clean is to change it often. Scored crankshaft bearings are found most frequently, it is said, in motors which have forced lubrication, indicating that grit is likely to be pumped into the bearings with the oil.

The crankcase dilution problem probably will be solved in engines of the future in one of two ways—either by a dry crankcase system or by a method of removing raw fuel from the lubricant in the crankcase and turning it back to the engine. In most cars built today, the lower part of the crankcase is an open reservoir in which the oil is carried. Raw fuel, leaking past the pistons, is readily absorbed by the oil in this reservoir. This holds true for full pressure lubrication and full splash lubrication alike.

Experimental cars have been designed to operate with dry crankcase, the oil being carried in a separate reservoir integral with the crankcase. In this system, oil is pumped out of the crankcase as fast as it collects and is delivered to the oil reservoir, where another pump forces it back through the various oil channels which lubricate the engine.

Since the interior of the crankcase is practically dry, there is little opportunity for the raw fuel, leaking past pistons, to be absorbed by the lubricating oil. Furthermore, the walls of the cylinders and the crankcase are so warm that they readily vaporize any liquid fuel which trickles down the walls of this chamber, and this vapor is more than likely to pass out of the crankcase breather since there is very little oil lying around to absorb it.

A still more effective method recently invented by William F. Parish, a lubrication engineer, adopts a simple apparatus for removing the fuel from the crankcase. By its use, the oil dilution is always kept below one per cent, which, of course, is negligible. The oil in the crankcase is drawn up through a small heating device, clamped to the exhaust pipe, which vaporizes the gasoline in the oil. Thence, the pipe leads to a cylindrical tank in which there are two chambers side by side. The first is a settling chamber and the second is a float chamber. The top of the float chamber is connected with the intake manifold by a small pipe and the bottom has a pipe running back to the crankcase.

The float apparatus is similar to that found in a vacuum tank and works intermittently. The object in connecting with the intake is threefold. Vaporized gasoline is delivered back to the engine, where it is burned; the intake supplies a vacuum, which greatly facilitates extraction of the fuel from the oil, and, by suction, it provides a means for automatically circulating the oil through the apparatus.

How Fuel Is Utilized

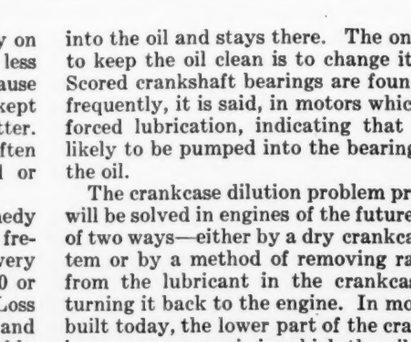
The suction first draws oil from the crankcase up to the heating unit, where the fuel is vaporized; then the oil passes to the settling chamber, where dirt and metal particles fall to the bottom. The vaporized fuel passes on to the engine, while the cleansed oil eventually flows into the float chamber, where it returns to the crankcase. Not only is all fuel removed from the oil, but the settling chamber keeps the oil clean.

The sludge obtained from the bottom of the settling or reclaimer tank usually contains about 12 per cent of carbon and 13 per cent of a mixture of silica and metal, the remaining 75 per cent being oil mixed with these solids. The silica, of course, is road dust, while the metal particles are worn off of the inside of the engine. Both are injurious to the wearing surfaces of the engine.

The use of this oil reclaiming device, besides keeping the dilution down to less than one per cent, permits the use of a light oil on which the engine can operate with maximum efficiency and power and with a minimum amount of carbon deposit.

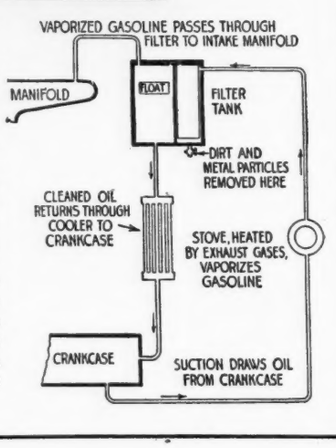
The system has comparatively few moving parts, is simple and reliable.

Oil reclaimers of this sort, since they may be applied to automobiles in use as well as to new cars, may be expected to have an immediate effect in solving the crankcase dilution problem, not only saving power, but conserving America's oil.



Gasoline Recovered from Diluted Oil Used as Fuel by New Method

THE invention of William F. Parish for recovering gasoline from crankcase oil and turning it back to the engine is shown in the accompanying photograph and diagram. Crankcase oil is drawn through a heater which vaporizes the gasoline, then to a filter tank. The vaporized fuel passes to the engine, while the cleansed oil flows into a float chamber and from there through a cooler and back to the crankcase

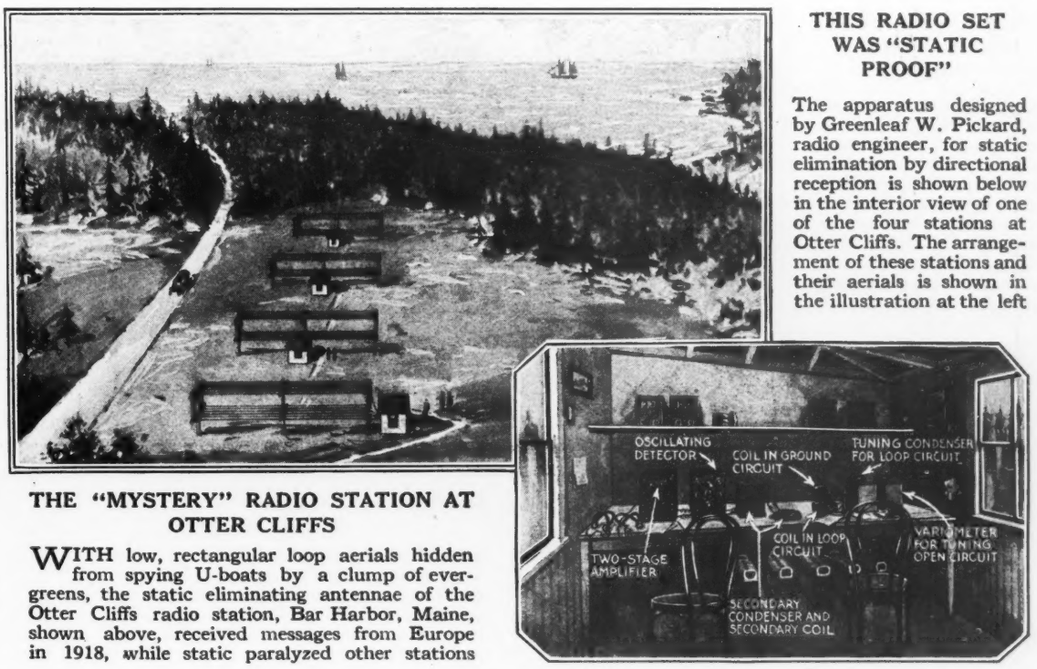

VAPORIZED GASOLINE PASSES THROUGH FILTER TO INTAKE MANIFOLD
MANIFOLD
FLOAT
FILTER TANK
DIRT AND METAL PARTICLES REMOVED HERE
CLEANED OIL RETURNS THROUGH COOLER TO CRANKCASE
STOVE, HEATED BY EXHAUST GASES, VAPORIZES GASOLINE
CRANKCASE
SUCTION DRAWS OIL FROM CRANKCASE

The Breeding Place of Static Discovered

Amazing War Record of Uncle Sam's "Mystery" Radio Station Points to Gulf of Mexico as Source of Wireless Jinx

DID you know that radio interference from "static" during the summer of 1918 threatened the success of the war and jeopardized the lives of hundreds of thousands of American soldiers on transports crossing the Atlantic? And did you know that these lurking disasters were overcome through the generosity of an American citizen and the ingenuity of American radio engineers who combined their resources to make of an obscure radio station on the New England coast one of the outstanding accomplishments in wireless of the war years?

The successful elimination of static in the reception of radio messages from Europe during that crucial summer, at the Otter Cliffs station, near Bar Harbor, Maine, forms a chapter of history of unusual interest to hundreds of thousands of persons to whom static is a new experience this summer.



THE "MYSTERY" RADIO STATION AT OTTER CLIFFS

WITH low, rectangular loop aerials hidden from spying U-boats by a clump of evergreens, the static eliminating antennae of the Otter Cliffs radio station, Bar Harbor, Maine, shown above, received messages from Europe in 1918, while static paralyzed other stations

THIS RADIO SET WAS "STATIC PROOF"

The apparatus designed by Greenleaf W. Pickard, radio engineer, for static elimination by directional reception is shown below in the interior view of one of the four stations at Otter Cliffs. The arrangement of these stations and their aerials is shown in the illustration at the left

The Crucial War Test

For 15 years up to 1918 paralyzing interference from static was the greatest obstacle in transatlantic radio communication. "Grinders," "clicks," "sizzles," and "crashes"—to identify the four varieties of static by their distinctive sounds as heard through the phone receivers—frequently disrupted radio communication for hours and sometimes for days at a time. Constant but slow progress toward their elimination had been made, but no decisive advances came until 1918, one of the busiest of busy war years, when regular, dependable communication became absolutely essential.

At that time the cables connecting this country and Europe were crowded to their limit with vital messages. It required no imagination to figure the consequences if the enemy should succeed in cutting these transoceanic links. To prevent any such disaster it was decided to place as much reliance as possible upon wireless communication.

Shortly after America entered the war, a wealthy radio amateur, Mr. Alessandro Fabri, completed the erection of a wireless station at Otter Cliffs. As soon as it was in successful operation, Mr. Fabri generously turned it over to the government. It had not been designed as a transatlantic station, but engineers quickly perceived its possibilities for this work, due to its location.

Soon after the government had taken over this station, it was discovered that, as a rule, messages from Europe were coming in regularly and with good signal strength, but that, on occasion, the static was so heavy as to be overwhelming. Recognizing the seriousness of this condition in wartime, Mr. Fabri invited radio experts of the Wireless Specialty Company to install receiving equipment that would eliminate static or at least reduce its intensity. How this was accomplished, the simple devices employed, and the thoroughness of the results obtained, constitute one of the most important, but least known, stories of "impossible" obstacles surmounted by this country during the war. The accomplishment has to do with remarkable theories and discoveries regarding the breeding places of thunderstorms and their relation to static.

Senator Marconi is believed to have been the first to discover that static was directional and that it did not descend upon the aerial from all points of the compass, but appeared repeatedly from the same general direction. In revealing his theory in 1906, he suggested that attempts be made to link together the periods of severest static with the occurrence of thunderstorms throughout the world.

How Static Was Traced

Following Marconi's suggestion, radio engineers made a series of measurements in which loop aerials were used to determine the direction from which the static attacks seemed to appear. Measurements made on the eastern coast of the United States showed the path of the static waves to be from the southwest. Similar measurements taken on Goat Island in the Pacific Ocean gave the direction as southeast. By extending these two lines the breeding place of static was traced to an area in the Gulf of Mexico or the states bordering on it.

To verify these computations and the theory of Marconi, official records of all thunderstorms for a period of 10 years were obtained from the United States Weather Bureau. These reports showed that thunderstorms appeared with greatest frequency over the western coast of Florida and over New

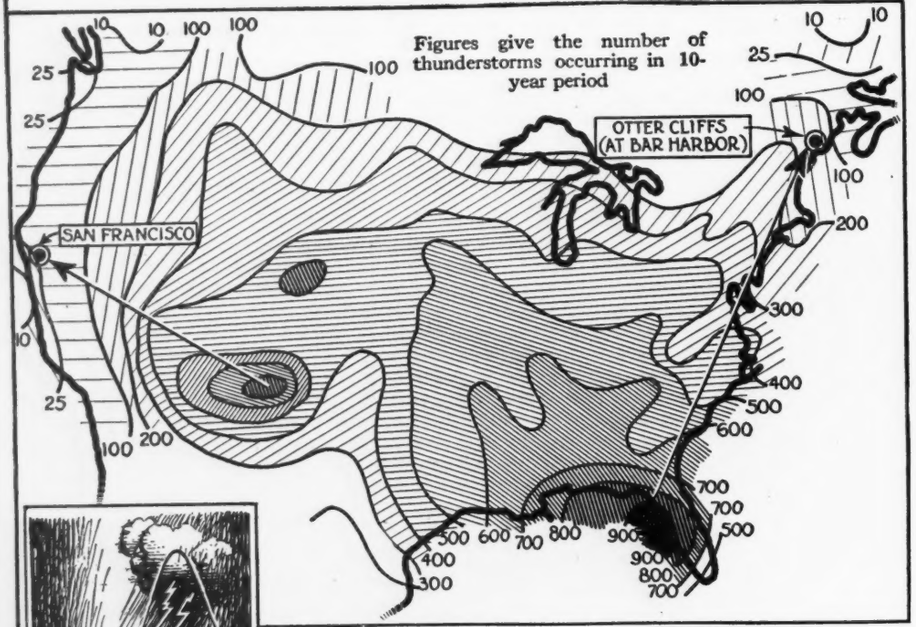
What Marconi Discovered

EVERY radio station in the world must combat static in its own way, according to observations of Senator Guglielmo Marconi. While crossing the Atlantic recently in his radio equipped yacht "Electra," Marconi noted that static impulses which came out of the east during the first half of the westward journey disappeared in mid-ocean and were replaced by other impulses coming from points in America known as prolific breeders of thunderstorms.

Further data have been obtained from a party of radio engineers sent to South America to study the problem. They report that static interference below the equator seems to originate on or near certain parts of the African coast where terrific electrical disturbances most frequently take place.

Leaving out of consideration the local static caused by near-by thunderstorms, these observations uphold, strikingly, the theory, advanced by Greenleaf W. Pickard, of the coincidence of static and thunderstorms, as explained in this article.

A Thunderstorm Map of the United States



THE THUNDER HOURS

This curve shows frequency of thunderstorms during the day. The static "trouble curve" is nearly identical

STORM CURVE

Both static and thunderstorms follow this monthly frequency curve, being most severe in summer

THE above weather map, showing the total number and distribution of thunderstorms in the United States over a 10-year period, tends to prove a direct connection between thunderstorms and static. The maximum storm areas, one over the western coast of Florida, the other in New Mexico, lie southwest of the Otter Cliffs station in the North Atlantic, and southeast of the Goat Island station on the Pacific, respectively. From these same directions originate most static disturbances recorded at the two stations

Mexico. As a clinching argument, the appearance of thunderstorms from month to month was compared with the monthly variations in static. The two records agreed perfectly, indicating that static in some manner was dependent on the formation of thunderstorms in the principal storm centers of the western hemisphere.

But conclusive as these figures seemed, it was quickly realized that lightning flashes from thunderstorms could not be held responsible for all the static impulses. By actual count the number of separate impulses in "grinders"—the most flagrant and demoralizing of the four varieties of static—averaged 10 a second. If lightning discharges were the sole cause of grinding static, it would require several hundred thousand or even a million discharges a day, which is an absurd theory, entirely disproved by official records.

The Pickard Explanation

An analysis of these facts led Greenleaf W. Pickard, one of the earliest workers in static elimination, to propound a theory which placed all the blame for static on high level electrical disturbances, that is, discharges from one cloud to another or from one part of the cloud to another part of the same cloud. It was his belief that these equalizing discharges, constantly moving from one atmospheric level to another below it, created natural radio waves which, passing downward toward the earth, produced static in the receiving phones.

According to the Pickard theory, one thunderstorm a day would generate the severe static conditions encountered at radio stations. As it is a rare summer day that does not see a storm along the Gulf Coast, the preponderance of static in summer, and from the south and southwest, seems to uphold the theory.

All of the experiments at Otter Cliffs were based on this principle of the generation and propagation of static waves. By a happy coincidence the site of the station lay on a line between the most important stations of Europe and the hotbed of thunderstorms in the southwestern part of the country. This fact, instead of complicating the problem, determined the procedure of the engineers, for by employing a combination of loop and open aerials it was figured that the signals from Europe could be brought in clearly, at the same time toning down the static crashes from the southwest.

The loop antennae erected at Otter Cliffs consisted of four turns of No. 16 copper wire arranged in the form of a square coil 97.5 feet long and 18.3 feet high. The entire loop was elevated 12 feet above the ground and pointed in a northeast and southwest direction. The open antenna was made up of the wire connecting the set with the loop aerial. Using this combination antenna and two stages of audio frequency amplification, signals from the great stations at Rome, Lyons and Carnarvon came in 1000 times louder than the minimum necessary for audibility.

Each of these two types of aerial has its individual characteristics. The loop aerial receives best from the directions in the plane of its coil of wire. When the coil is turned at right angles to the signals, practically no sounds will be heard in the phones. The vertical aerial receives equally well from all directions.

Knowing this, the beginner in radio will naturally wonder how the combination of loop and vertical antenna can be made to be selective and receive from one direction only. This requires a general idea of the action of the two types of aerials.

How Loop Aerial Works

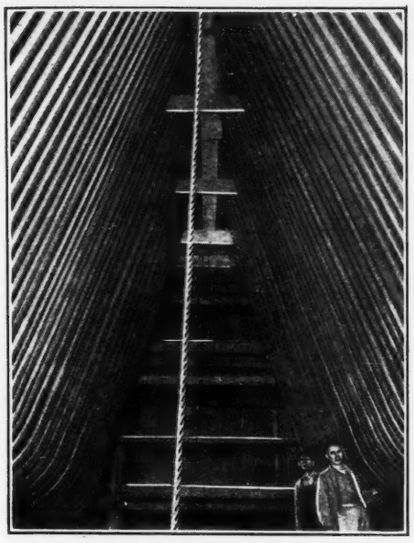
If a loop aerial is considered as two vertical wires erected some distance apart and connected across their top ends by a third wire with the receiving set connected across the bottom ends of the vertical wires, the explanation is simplified. If such a loop is turned so that the plane of the vertical wires is at right angles to the incoming wave, both wires will be affected at the same instant and the impulses going down the wire to the radio set will meet and, being equal, will neutralize each other. No sounds will be heard in the phones. But if the aerial is turned 90 degrees so that the two vertical wires are in a direct line with the sending station, the electric impulses will strike first one wire and then the other. This condition will produce an unbalancing in the receiving circuit and the vibrations thus set up will operate the phones. When these sounds are loudest the operator knows that the loop is pointing either toward or away from the sending station.

To make the antenna directional, it is necessary to erect a second aerial consisting of a single vertical wire open at one end and grounded at the other. The two aerials receive impulses, but being interconnected in a certain manner, the signals from one direction add to each other while undesired signals or sounds from other directions are cancelled. Thus if the antenna were set northeast, as at Otter Cliffs, the stray impulses from the southwest, after striking the combination antenna, would be neutralized, allowing clear reception from northeasterly stations only.

The Record of Otter Cliffs

During the summer of 1918, the static from the southwest was unusually severe. Throughout that summer, the station at Otter Cliffs, with combination loop and open antenna, succeeded in carrying on uninterrupted conversation with foreign stations while other radio receiving stations along the eastern coast were unable to thread the maze of static interference.

During one forenoon, while a thunderstorm hundreds of miles distant was forming, the signals coming in from the station at Nauen, Germany, were three times louder than the static when using only the loop. With the combination antenna, the message signals became seven times louder than the static. Later in the afternoon, when the roar of the static was at its height, the message signals were only one fifth as loud as the static, making reception impossible with the simple loop. But upon adding the vertical aerial, the static was subdued; and instead of being obliterated by the meaningless cracklings, the signals were four times as loud as the static.



World's Largest Boiler Will Heat 1000 Homes

THE largest boiler in the world, recently installed in Detroit, Mich., is capable of heating 1000 eight-room houses. It will be used to supply heat and power to the business district of the Michigan metropolis. When running at full capacity, the boiler will turn 190,000 pounds of water into steam every hour, requiring between 12 and 13 tons of coal.

The interior of the boiler is 19 by 26 feet, and the height from the grate bars to the top of the pipe coils is 35 feet.

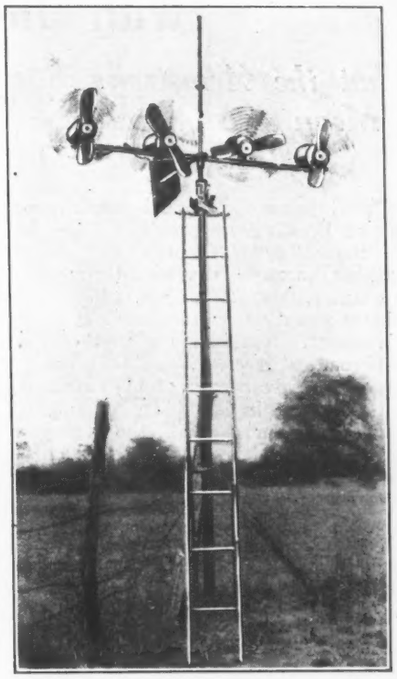
Small Windmill Wheels Charge Battery

AN UNUSUALLY light and simple windmill for generating electric current for battery charging, recently invented, consists of a number of small, independent wind wheels or impellers mounted on the crossbar of a pole or mast that may be erected in any convenient place, such as an open field or at the top of a building. Each wind wheel drives a little dynamo, rated at 40 watts, which delivers its quota of current to the battery.

Charging commences with a wind of 15 miles an hour. The stronger the wind, the greater the speed and output. The crossbar on which the impellers are mounted is fitted with a vane and arranged so as to turn and always keep the impellers facing the wind.

An automatic cutout is provided in the circuit so that at low or no speed there is no back flow of current from the battery. For this purpose the shaft of one of the dynamos is arranged with a small amount of end movement. On the end of the shaft is a contact plate and opposite this plate is a pair of contact bars or fingers supported on the frame.

As long as the force of the wind is sufficient, the dynamo shaft presses the contact plate up against the fingers, thus completing the circuit, which is broken again when the wind pressure falls below that necessary to generate sufficient current for charging the battery. In this way the cutout also serves the purpose of an automatic switch.



Each small windmill, shown above, drives a dynamo, rated at 40 watts

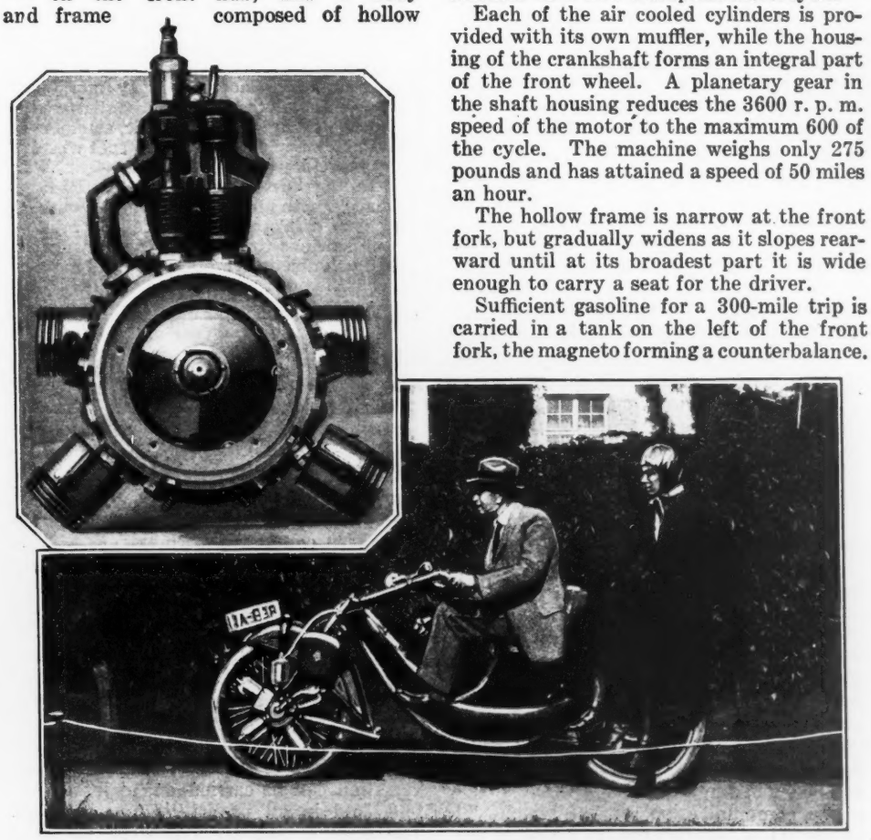
Front Wheel Engine Drives Novel Cycle

A FIVE cylinder rotary engine mounted on the front hub, and a body and frame composed of hollow sheet steel members, are the surprising features of a new European motorcycle.

Each of the air cooled cylinders is provided with its own muffler, while the housing of the crankshaft forms an integral part of the front wheel. A planetary gear in the shaft housing reduces the 3600 r. p. m. speed of the motor to the maximum 600 of the cycle. The machine weighs only 275 pounds and has attained a speed of 50 miles an hour.

The hollow frame is narrow at the front fork, but gradually widens as it slopes rearward until at its broadest part it is wide enough to carry a seat for the driver.

Sufficient gasoline for a 300-mile trip is carried in a tank on the left of the front fork, the magneto forming a counterbalance.



How the rotary engine, shown partially disassembled in the inset, is mounted on the front hub. Note the ingenious, tapering hollow frame

Germ Proof Jackets for Paper Money

TRANSPARENT germ proof envelopes for paper money are being adopted as a sanitary measure by one large Chicago business house, and also by a number of firms in France, where bills are printed on inferior paper stock.

The envelopes are of thin, smooth and transparent paper that protects the money from infection and, owing to its hard and smooth surface, is a highly unfavorable medium for harboring germs of any kind.

Dr. J. C. Graham, of Columbus, Ohio, recently made a series of bacteriological tests of paper money.

Fourteen soiled bills of one and two dollar denominations were immersed in sterilized water in separate containers. From the water in each container one tenth cubic centimeter was added to a tube of nutrient gelatin and from each of these tubes another tube was inoculated. In every case cultures of from one to five different kinds of bacteria were obtained.

On the Crest of the Radio Wave with Jack Binns

What the Armstrong Super-Regenerative Circuit Will Mean to Broadcasting—Tremendous Amplification without Noise—The Pioneers of Wireless

THE present practical applications of E. H. Armstrong's already famous "super-regenerative" circuit have been thoroughly discussed throughout the country, since the young radio wizard made the sensational announcement of his achievement. He has given us the ideal radio broadcast receiver.

The main advantages of his circuit in this respect lie in its ability to amplify 100,000 times more than the regenerative circuit, and the ease with which it completely wipes out wireless telegraph signals caused by sparks, and also a large amount of static.

The probable developments of the system in the immediate future are as interesting as its present use. It will open up to us a band of wave lengths, low down in the scale of etheric vibrations, which man hitherto has never been able to harness.

Perhaps I can best emphasize the importance of this by referring the reader to my last article in POPULAR SCIENCE MONTHLY, in which I outlined the possibilities of using reflected electromagnetic waves for the purpose of covering greater distances with a minimum power output, and at the same time insuring greater secrecy in communication.

Now, the latest of the Armstrong inventions, coupled with some recent experimental work of C. S. Franklin in England, places this possibility in the realm of actuality. With the super-regenerative receiver, it soon will be possible to communicate over vast distances by radiotelephony upon a reflected beam of electromagnetic waves.

The Facts about Short Waves

To the radio fan there is, of course, a great deal of mystery concerning the short waves. He cannot understand why it is they cannot be used as freely as the longer waves. Unfortunately, it is necessary to revert to figures to illustrate why this is so, but in using them, I will endeavor to be as simple in my explanation as the complicated circumstances permit.

In the first place, it must be taken for granted that interference between radio stations is caused by the frequency of the oscillating electric currents radiated into space. The closer together these frequencies are, the greater the interference. This will be readily seen when I explain that the frequency of a 6000-meter wave is 50,000 cycles a second, while the wave length of 6500 meters has a frequency of 46,150 cycles a second. Thus, there is a frequency difference between the two waves of only 3850 cycles a second, despite the fact that in wave lengths there is an actual difference of 500 meters.

Now let us inquire into the situation that exists around wave lengths of, say, 10 meters. A wave length of 10 meters means a frequency of 30,000,000 cycles a second. Correspondingly, a wave length of 11 meters means a frequency of 27,272,727 cycles a second. You can see, therefore, at a glance, how important the difference really is, because in this case, where there is a difference in wave length of only one meter, we have a frequency difference between the two waves of 2,727,273 cycles a second.

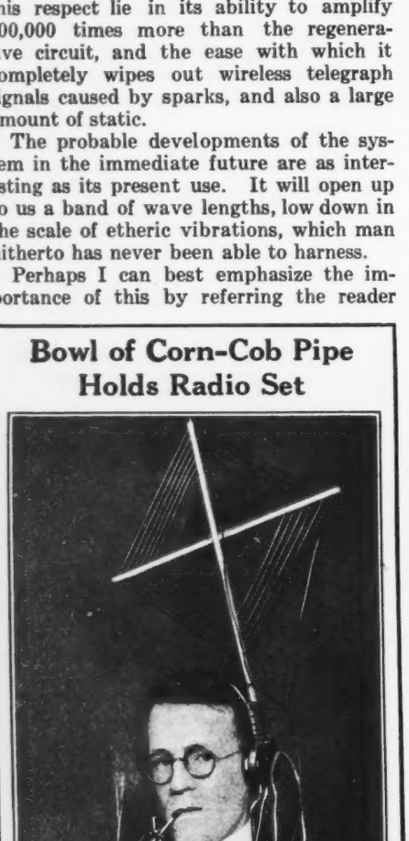
An End to Interference

On wave lengths below 50 meters it will be possible for transmitting stations to operate within half a meter in wave length of each other without interference. For opening up these wave lengths to us, Armstrong has made an advance in the art of radio that is truly epochal. This, however, is not the only possibility of which the super-regenerative receiver is capable. By these very same short waves, a new era will be opened in the realm of wireless telephone communication, an era which will be devoid of interference, and also of the situation where every one listening in on the ether can hear what is being said. In other words, it will give us far greater secrecy than we have yet attained.

During the past few months, some interesting experiments have been conducted in England by C. S. Franklin, using a reflected beam of high frequency oscillating currents as carrier waves for wireless telephone communication. These experiments have been conducted with extremely short waves, and have been successful over distances of 100 miles. Of course, no one, except those in a direct line between the two points, could hear the conversation.

The drawback to this system so far, however, has been the uneconomic manner in which the signals must be detected. The new Armstrong system will not only overcome this difficulty, but it will increase the distance over which this kind of conversation can be carried on, at least fourfold, and in all probability much more. The time is not far off when we shall be able to telephone to Europe on short wave lengths, with low power, in the same

Bowl of Corn-Cob Pipe Holds Radio Set



THE most compact radio receiving set that has made its appearance is built on the bowl of a corn-cob pipe. It is the work of F. E. Wilson, of Detroit, who can fill his pipe at the close of day and settle back for a smoke while he tunes in the radio stations that are "in the air."

For an aerial, Mr. Wilson uses a small loop attached to the headband of his 2000-ohm phone. The tuning coil is made of 100 turns of enameled wire—No. 26—wound around the bowl of the pipe. A piece of galena is balanced on the pipe stem, while the catwhisker is arranged to pivot on the stem. This small set has been remarkably successful in picking up concerts within 10 miles of the broadcasting stations.

America's Most Popular Radio Expert

JACK BINNS, the wireless operator who first awakened the world to the future of radio when, in 1909, he flashed the historic "CQD" call for help from the sinking steamship Republic, is today one of America's foremost interpreters of radio's amazing progress.

With the same clear-cut forcefulness that characterized his action in sending the thrilling message that saved 1650 lives from disaster at sea, Jack Binns is now devoting himself to the task of aiding thousands of new radio enthusiasts who might otherwise be foundering in a sea of technical difficulties.

Each month, in Popular Science Monthly, he explains radio's mysteries in words and phrases that everybody can understand, clearing up the big difficulties that often puzzle the beginner, and offering valuable suggestions for improving the reception of radio messages and entertainment.

BECAUSE of his great success in keeping everyday men and women in touch with the rapidly advancing achievements in wireless, Binns is known as America's most popular radio expert.

One of the first commercial wireless operators, he has kept abreast of the subject, ever since the foggy morning when he stuck to his key in the shattered wireless cabin of the Republic, summoning nine rescuing ships to the spot where his vessel lay sinking.

Riding "On the Crest of the Radio Wave" with Jack Binns each month, readers of Popular Science Monthly will continue to receive keen enjoyment and valuable information that will make the radio outfit doubly worth while.

manner as the amateurs telegraphed across the Atlantic last year.

Another important point that must be remembered is the fact that static is not nearly so bothersome on short waves as it is on the longer waves. The new Armstrong system with its rapid change to positive potential, cuts off more than 50 per cent of static interference automatically, before it has an opportunity to develop free vibrations in the circuit.

This is all very fine for the future, you will say, but what we are interested in is the present. How does this new system operate? How can it actually amplify 100,000 times greater than does the regenerative circuit? How does it cut out static and spark telegraph signals?

Putting the Squeal to Work

To answer these questions in a non-technical manner is somewhat difficult. However, I am reminded forcibly of the slogan of the stockyards: "Everything is used but the squeal." This is rather appropriate to the new radio system. You all know that the regenerative receiver squeals very badly after the tube reaches the oscillating point. Now Armstrong has not only utilized the last ounce of energy in the vacuum tube, but he has eliminated the horror of the squeal by setting it to work usefully, and in this way gets the terrific amplifying results that have astonished the radio world. In other words, Armstrong even uses the squeal.

Another way of expressing it is to say that the remarkable amplification is obtained not by a steady push, as in the case of the regenerative circuit, but by a series of lightning-like blows delivered by the feedback circuit; and it is these lightning-like blows that strike out of existence all free oscillations in the circuit before they have a chance to develop. That is the manner in which spark signals are entirely eliminated by the Armstrong system.

Amplification Minus Disturbing Noises

I HAD planned to discuss at some length the possibilities of radio-frequency amplification, as that is the subject which has taken hold of radio fans throughout the country, and I know that there is a general desire to experiment with this elusive feature of radio reception. The announcement of Armstrong's latest discovery has changed my plans, but not my intention.

As a matter of fact, it would be well for my readers to ponder over this significant statement, which I am making without any reservation whatsoever:

The Armstrong super-regenerative system is the true form of radio-frequency amplification, because, by it, the regeneration is performed before the incoming signals are actually rectified.

Under the circumstances, therefore, a discussion of the new system naturally leads into a consideration of radio-frequency amplification, and the problems concerning it.

In the first place, the reason why radio-frequency amplification assumed such a big rôle is because, as is well known, there are two disadvantages to audio-frequency amplification. First, the latter form of increasing the strength of signals is dependent upon the ability of the detector to pass current along to the amplifying section of the receiver; and second, this form of amplification, being of an audible character, increases all the other noises that are heard in the radio receiving set.

Now it was realized that much greater distances could be covered if it were possible to build up the radio, or carrier waves, which were received by the aerial. Many of these waves were far too feeble to actuate the detector, but experience proved that they could be built up by successive stages of vacuum tubes arranged on the well-known "cascade" principle. This system worked admirably upon long waves, but when it came to be applied to short waves, it was a miserable failure.

This failure was due to two principal causes. The first of these was the fact that the vacuum tube itself has capacity between its elements, and so acts as a feed-back to the transformer windings placed between the radio-frequency tubes. The second cause was the difficulty of building a transformer that would work satisfactorily at the terrific frequencies involved, which, in the case of a wave length of 360 meters, is 833,333 cycles a second. Also, no two tubes are exactly alike in their capacity, and therefore no stable results can be obtained.

"Cascade" Method Supplanted

Far be it from me to declare that radio-frequency amplification by the "step by step" or "cascade" method will never be accomplished, but I do not hesitate to say that Armstrong's discovery will supplant the importance of such radio-frequency amplification for many years to come.

I make this prediction because I know Armstrong well, and have the greatest faith in him and in his work. I am convinced that the guiding hand of genius hovers over him. He is without any question the most imposing figure in the world of radio today.

The Real Pioneers of Wireless

ALL of the above causes me to glance back at the early stages of the wireless art, and to recall some of the early struggles with crude apparatus. The consideration of Armstrong's place in radio also brings out the tragic position which one man will ever hold in the annals of wireless development.

I speak of Professor D. E. Hughes, the British scientist, who, in actuality, was the real discoverer of wireless telegraphy, just as much as Professor Langley was the real discoverer of the possibility of mechanical flight in the air.

In fact, there is a great deal in common between the historical importance of these two men in their respective spheres. It is a historical fact that a few years before Marconi made his announcement to the world, Professor Hughes demonstrated his system (which was based on the same principle as Marconi's) to a few friends in London, and succeeded in telegraphing from one room to another without any intervening wires. His friends, however, scoffed at the system, and ridiculed its inventor.

Professor Hughes was one of those high-strung beings who could not withstand the effect of ridicule, and he gave up his plans in despair. In fact, his death was

Aerial for Canoe Collapses into Hoop

The spiral antenna, suspended from poles at stem and stern, telescopes into a small loop shown at right

TELESCOPING antennae and compact radio-phone outfits now make it possible to enjoy radio concerts aboard small craft such as canoes and motor boats. The required length of aerial wire is obtained by a multitude of coils suspended from short poles at stem and stern. Straight longitudinal wires take up the strain and prevent the coils from sagging.

With a simple aerial of this type radio-telephone concerts can be enjoyed many miles from the broadcasting stations, and with a five-watt power tube, two-way conversations can be carried on with other stations within a few miles.

When dismantled, the spiral antenna collapses into a space no larger than that occupied by the hoop of a barrel.

hastened by his bitter disappointment.

I am just bringing this tragic memoir from the past to the attention of the radio fans in order to emphasize the fact that credit does not belong to the man who discovers alone, but to the man who, having discovered, has the courage to push his discovery to its logical conclusion against all the forces of ridicule or reaction which are brought to bear against him.

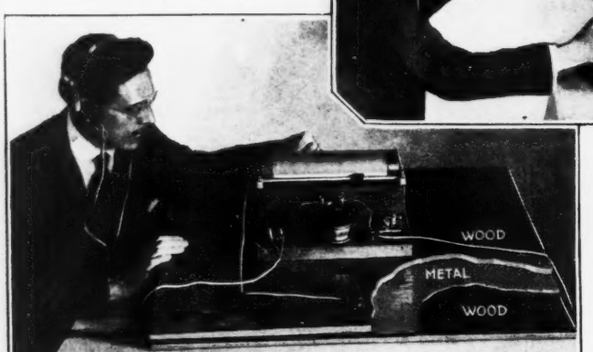
Armstrong, in his battles against enormous odds, has shown that he is built of that caliber.

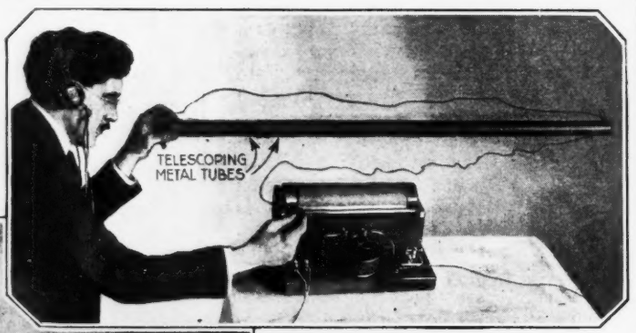
The First Apparatus

In an out-of-the-way niche of the remarkable South Kensington Museum in London, there rests the crude piece of apparatus used by Professor Hughes. The recent discovery of this first wireless apparatus in an obscure London tenement, was announced in the August issue of POPULAR SCIENCE MONTHLY. Resting beside it in the South Kensington Museum, is the original outfit of Marconi; but it is upon Marconi that the title, "Discoverer of Wireless," has rightfully been bestowed by history. The public does not generally recognize, however, that Marconi's two really great claims to fame in the early history of radio lie simply in his invention of the aerial and ground connection, and in his success in putting the new art on a commercial basis.

Two New Types of Indoor Antennae

OF THESE two interesting indoor aerials, designed by John W. Everard of Brooklyn, N. Y., the one pictured below consists of a metal plate three feet square, completely insulated from its shallow wooden container. The plate is covered with a solution of silver nitrate to make it a good conductor





TWO telescoping metal tubes, insulated from each other, compose the second type of aerial, shown above. Connecting the two tubes is a flexible cord, from which the lead-in is carried to the tuning coil. With a five tube set, including two stages of radio frequency amplification, Mr. Everard says he has received clearly from stations 150 miles distant

Barrage Loop Kills Static

ALTHOUGH the tail-end of the season for static is approaching, many readers continue to ask questions about it. The most important discoveries and theories about the origin and nature of static and its coincidence with thunderstorms, as revealed by the remarkable achievements of the Otter Cliffs wireless station, near Bar Harbor, Maine, during the war, are interestingly described on pages 67 and 68 of this issue.

Armstrong's new system eliminates much of the static, but it will be many months before Armstrong's system is in general use, because of the time it will take to construct the necessary apparatus. Under the circumstances, therefore, it may be well to point out what can be done with existing apparatus.

One of the best ways to cut out interference of all kinds, static included, is by the use of the barrage loop in conjunction with the regular aerial system used by the radio fan at his home. The operation of the loop is similar to those used at the Otter Cliffs station.

The best manner to employ this system is by constructing a four-foot loop with six turns of No. 18 copper wire, spaced half an inch apart in the usual manner. This loop must be tuned to the 360-meter wave, and if the number of turns is too large, attach the connecting clip along the wire until the right amount has been obtained.

The loop should be connected in series between the secondary of the variocoupler and the grid variometer; or between the secondary inductance and secondary condenser in other types of circuits.

Now, this loop acts exactly in the same manner as other loops do, except that it will not record signals coming from the direction opposite to that which the loop is pointed, and in this respect is more selective than the regular loop. If the loop is at right angles to the incoming signal, no sound will be recorded in the telephone.

Therefore, it will be seen that with the barrage loop, all signals will be completely obliterated, except those coming from the direction toward which the loop is pointed. The same is true also of static.

There has been much talk lately of another novel way of eliminating the effect of static—the use of an underground antenna. This is arranged by burying in the ground an insulated aerial several hundred feet long. Its length is impracticable for most radio fans, however, especially those in the cities. Moreover, the results do not warrant the effort.

Two Indoor Aerials

IN THIS connection, John W. Everard, of Brooklyn, N. Y., writes us that he has achieved some satisfactory results with interesting indoor aerials. One of his types consists of a metal plate about three feet square, thoroughly insulated on all sides from the box holding it. To make the plate a good conductor, it is covered with a solution of silver nitrate. Mr. Everard has found that this antenna is not directional, but picks up stations from all points of the compass with equal intensity. Using a crystal detector, he says, radio-telephone messages have been received from stations 20 miles away.

Another of Mr. Everard's aerials consists of two telescoping metal tubes insulated from each other. A flexible cord connects the two tubes and from this cord the lead-in is carried to the tuning coil. The capabilities of this tube antenna, he says, equal those of the plate aerial. With an outfit comprising two stages of radio frequency amplification, a vacuum tube detector and two stages of audio-frequency amplification, radio-phone stations 150 miles distant are said to have been heard clearly.

What Do You Want to Know?

Radio Questions Answered

WHEN TO USE A LOADING COIL

May a loading coil be used to increase the wave length of a set?

In the single circuit type of set, a loading coil in the antenna circuit is sufficient to increase the wave length of the set. In the two circuit type, if the antenna circuit is loaded, it will also be found necessary to load the secondary circuit so that the secondary circuit can be brought to resonance with the primary circuit; while in the three circuit type, you will find it necessary to also load the tertiary circuit. The honeycomb coil circuit, in which all three circuits can be changed to suit conditions of various wave lengths, is the best for all-round work for all wave lengths. For the broadcasting wave lengths however, it is not as efficient as the regenerative circuit using a variocoupler and two variometers.

AMPLIFIER WITH CRYSTAL SET

May an amplifier be used with a crystal detector?

Provided the in-put terminals of the amplifier are connected into the circuit where the head phones would otherwise be, amplifier units can be used with the crystal detector. The results however, are not as good as those which are obtained when a vacuum tube detector is used.

THE LOADING COIL AND RANGE

Will the use of a loading coil decrease the range of a single circuit?

As long as the resistance of the winding is not excessive, the use of a loading coil will neither increase nor decrease the distance range of the set with which it is used. In practice, this factor need not be considered.

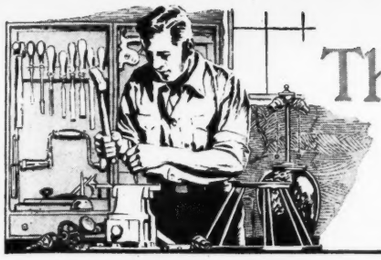
TIGHT AND LOOSE COUPLING

What are the respective advantages and disadvantages of "tight" and "loose" coupling?

"Tight" coupling makes a receiver responsive to a wide range of wave lengths without delicate adjustments of tuning elements and is best for general listening in, while "loose" coupling gives greater selectivity, making closer tuning possible.

EVERY reasonable specific query in the field of general science addressed to the Information Department will receive a prompt reply.

Address the Information Editor, Popular Science Monthly, 225 West 39th Street, New York City.



The Home Workshop

New and Useful Things to Make with Tools

Cheap to Build and Operate Is This Small Cyclomobile Speedster

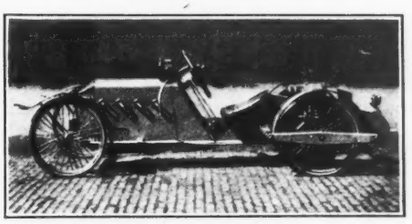
By William J. Beach

WHILE this little machine was not built in an attempt to eclipse all efforts of the automobile industry or even as a substitute for a motorcycle, it is a very satisfactory little car, and in actual use has proved its sturdiness, dependability, and low cost of upkeep.

The cyclomobile, as I call the small machine, is really a bicycle on four wheels, propelled by a bicycle power plant. If purchased at second hand, the motor may be obtained for a very small figure, and the total outlay for the machine in that case should not exceed $75.

On the road, the car will travel 20 miles an hour, and the engine, small as it is, develops sufficient power to climb all reasonable grades.

While the machine simulates in profile the appearance of a sport automobile, it is straddled as is a bicycle; this feature permits of mounting and dismounting quickly and at the same time affords a machine of extremely light construction.



The cyclomobile, as built by the author, gave reliable road service on many trips in and around New York

The main frame is comprised of a deep plank on edge, having a strip fastened flat along the bottom, the whole forming an inverted T beam. The wheels, which are 20 in. by 2 in., may be purchased from any dealer who handles certain makes of so-called "fliers." The rear wheels are mounted in two cradles made of hard wood and pivoted on a transverse member immediately behind the seat, as shown in the working drawings. The rear ends of the cradles are connected with a tube, that passes through a vertical slot in the rear of the frame. The slot is provided with a spiral spring to serve as a shock absorber.

The power plant and traction wheel are placed on the left side between the frame and the road wheel, so that the axis of the traction wheel is approximately in line with the axes of the two rear road wheels. This feature permits the three wheels to turn as on a pivot when taking a corner. The traction wheel should be hinged on a king bolt to allow it to ride over road irregularities.

A luggage carrier is secured to the frame by means of the angle brackets, as shown, between the frame and the right-hand rear wheel.

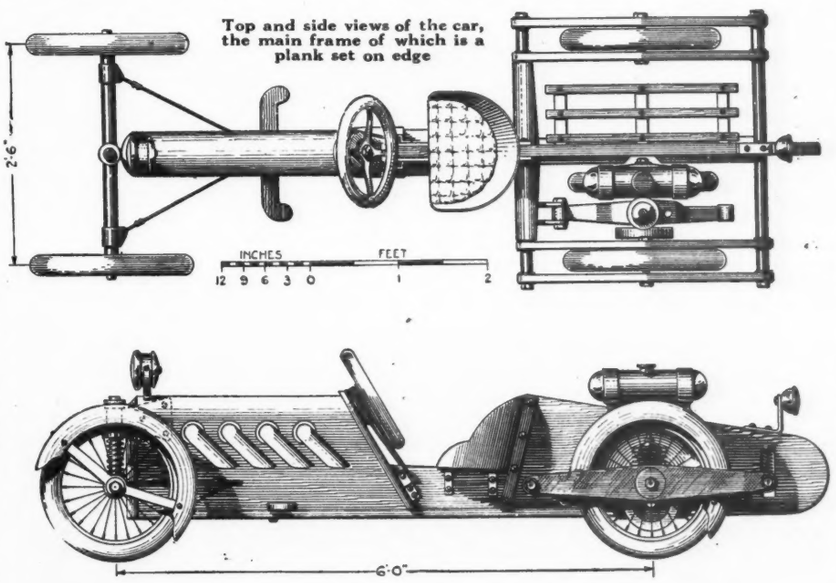
A sloping dashboard supports a spool-like flanged pulley and the steering wheel. These operate a multi-strand steel cable passing through V pulley guides.

The forward end of the frame is covered by a sheet metal cowl, which may have imitation exhaust pipes painted on it or may be treated in any way that seems most appropriate to the maker. Mudguards can be added at little additional expense, if desired.

The front axle is attached to a vertical plunger rod encircled by a compression spring, which takes care of the road shocks.

An adjustable footrest is mounted on the frame in a position to suit the comfort of the cyclomobile's operator.

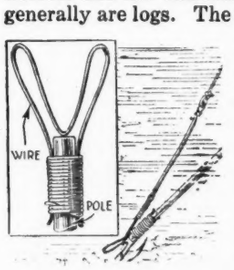
It is recommended that the machine be painted a dark battleship gray and striped with black; but the maker, if he has ample leisure to keep the car clean, can give the car a strikingly brilliant appearance with vermilion, auto red, azure blue, or any other favorite color.



Top and side views of the car, the main frame of which is a plank set on edge

Releasing Snagged Fishhooks

THOUSANDS of leaders and lines are lost annually to stream fishermen who fish with bait. The hooks sink to the bottom and are imbedded in snags, which generally are logs. The angler becomes impatient, jerks the line and either breaks the hook or the leader.



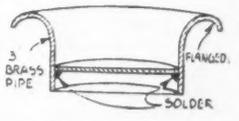
There is a simple method of preventing this loss. Carry along a wire twisted as shown, and when the hook becomes snagged, tie the prong to a long, slim sapling. Work the crotched wire down along the line, which should be kept fairly taut. When the prong reaches the log, a little manipulation and a sharp push or two will quickly bring the hook out.—ROBERT PAGE LINCOLN.

To Start Screws Easily in Awkward Places

ALTHOUGH there are many devices on the market for holding a screw while starting it in a place that is hard to reach, the best method I have found is to cut the end of a hard wood stick of convenient length so that it is wedge shaped like a screwdriver and slightly larger than the slot in the screw head so that it will hold securely when forced into slot. It is then possible to start the screw by using the stick as a screwdriver.—H. S. HART.

Tray Made from Brass Pipe

TAKE a piece of 3-in. brass pipe and flange over one end by heating the pipe and hammering it with the ball end of a machinist's hammer. When the flange has been made, cut off the pipe so that the piece will stand about 1½ in. high. Cut a sheet of brass to exactly fit inside the pipe, soldering it on the under side about ½ in. from the bottom. Finish with a file and emery cloth or a buffing wheel, if one is available.



A neat ash tray

I have flanged 3-in. brass pipe ⅛ in. thick without having the brass split at the flange.—H. O. SCOTT.

Model Sailboat Made with Tar Paper

By E. Bade

WHILE there is much to be said in favor of small paper boats, the difficulties of making them ordinarily have been too much for the model boat builder. Such boats were formed of cardboard and rendered seaworthy with bichromate of potash, which, when added to glue, makes it waterproof. If tar paper is used instead of cardboard, the construction is greatly simplified.

The framework of the model boat illustrated consists of a keel, a bow stem, a stern post, two transverse bulkheads, and the deck. The keel is ½ in. thick, ¾ in. wide and 18 in. long, both ends being cut square. The prow is ½ in. by 2 in. by 6½ in. One of the ½ in. edges is tapered from both sides to a knife edge and somewhat rounded at the base, so that when the piece is screwed to the keel the outside edge forms an unbroken line with the bottom edge of the keel.

The stern piece is the same size as the bow, ½ by 2 by 6½ in. A straight line is drawn, dividing it in two the long way, and then two curved lines are drawn to make a sort of V with a blunt point ½ in. wide. This can be seen distinctly in one of the accompanying photographs. Cut the piece out to the shape drawn and fasten it to the other end of the keel.

How the frame members and the deck and hatchway are shaped

Back from a long cruise

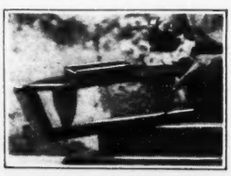
The two bulkheads are ½ in. by 4½ in. by 5½ in., shaped as shown in the left-hand illustration. The widest part should be about ½ in. from the top, and the narrowest part is no wider than the keel at the bottom, or ½ in.

From the parts already made, lay out the shape of the deck, which is a trifle larger than the top of the frame. The guide lines can best be obtained simply by turning the frame upside down on a board and drawing a line free-hand around it, making sure that the deck is the same in shape on both sides of the long center line.

When the deck has been sawed out, make provision for the cabin either by cutting along the lines of the hatch with a fret-saw, or boring out a series of holes that touch each other all the way around, later smoothing the edge with a penknife. When the opening is smooth and true, brad thin strips of wood around it to form a frame and make a sliding cover.

After the deck has been screwed to the framework, a piece of tar paper is tacked neatly and securely to it. The projecting edges should be trimmed with a knife only after the tacks are all in.

Provide a mast whittled from a stick of wood or made of thin bamboo. It should pass through a hole in the deck and rest snugly in a seat made by boring half-way into the keel. The sail may be made of any soft white cloth, cut as shown, or in any rig that the maker wishes to use.



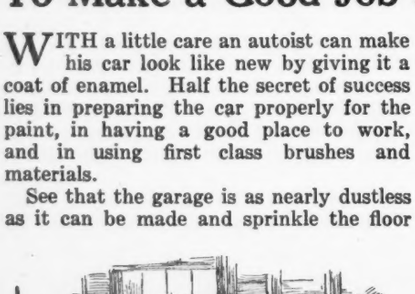
Before the boat can be sailed it must be weighed down with iron or lead. This is placed in the hole through the hatch and should be adjusted in weight and position so that the boat floats upright with the water line at least ½ in. below the deck.

Assembling and covering the framework

To Make a Good Job of Repainting Your Car

WITH a little care an autoist can make his car look like new by giving it a coat of enamel. Half the secret of success lies in preparing the car properly for the paint, in having a good place to work, and in using first class brushes and materials.

See that the garage is as nearly dustless as it can be made and sprinkle the floor with water. The temperature should be about 70 degrees, for the enamel will not flow properly at a lower temperature. Jack up the car before starting.



Looking like new

About one quart of standard motor-car enamel will serve to refinish a runabout or small touring car. If it is desired to change the color considerably, as from a dark to a light color, it will be necessary to use an undercoat. For wheels in natural wood finish and for instrument boards, a good waterproof finish will be required. Special finishes for the engine castings and dressings for the seat leather and auto top may also be obtained.

All mud, grease, and tar should carefully be removed by brushing and sponging the surfaces with gasoline. Remove whatever gloss remains of the previous finish by a liberal use of fine sandpaper and steel wool, or rub with pumice stone and water applied with a piece of burlap or thick felt. See that the surface is perfectly smooth. Wiping with a cloth on which a few drops of varnish have been placed will remove whatever grit and dust remain. Use a small brush to clean out corners around the upholstery where there is apt to be caked dirt. If the old finish is chipped off entirely in places, enamel these spots first of all and let them dry before coating the entire car.

The larger surfaces may be enameled with a 2-in. chisel-shaped or oval brush. Do not put on the enamel too thickly, as it will run and form "fatty" edges, and, on the other hand, do not allow the brush to go dry before redipping it. Great care should be taken to prevent the enamel running down the spokes of the wheels and gathering at the hub. A flat brush, 1 in. wide, will be best for the wheels and also for the smaller panels and moldings. In finally finishing a wheel rim, it is well to hold the brush lightly against it and turn the wheel. Usually the easiest way to do the hood is to remove it and stand it on end.

Do not overlook any part, because it is next to impossible to go back and retouch surfaces upon which the enamel has commenced drying. When the enamel is hard —after two or three days—carefully wipe off the car with a chamois skin, after washing it with cold water.—T. E. M.

Cut the Camp Fire-wood on this Sawbuck

THIS rugged sawbuck may be made quickly with no other tool than the bucksaw itself. Cut four shoots about 3 in. in diameter and 4 ft. 6 in. long and point the ends. Drive them into the ground as shown so that they rest at an angle of 45 degrees across a 4-ft. length of log 12 or 14 in. in diameter.

Made with ax or bucksaw

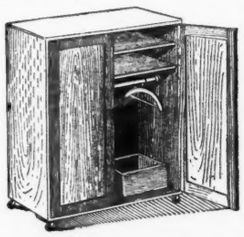
If a heavy log for the base is not handy, the four sawbuck legs can be notched together in pairs with rough, half-lap joints. They are driven into the ground in such a way that the notches in each pair come opposite each other. The joints are then bound together with wire.—JOE. V. ROMIG.

THE PLUS or positive side of the B battery must be connected with the plate or signals will not be detected.—F. J.

Converting Phonograph Boxes into a Children's Wardrobe

THIS wardrobe was made from two phonograph boxes purchased from a dealer for 25 cents each. The heavy strips were removed from the outside, and used inside as cleats in converting the two boxes into one. The whole was fastened together with threepenny casing nails. Doors were made and fitted, and knobs, catches, and ball bearing casters attached.

After the wardrobe was well sandpapered, it was enameled in French gray. Other finishes might have been used, such as ivory enamel, walnut, or dark oak varnish stain.



A cheaply made piece of furniture

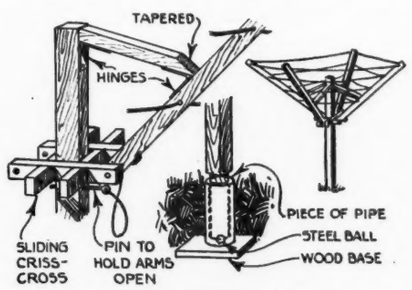
Any arrangement of shelves may be made. In this instance, two shelves were fitted in the upper part with a rod for clothes hangers, below, and a box for rubbers and overshoes was provided at the bottom.

An interesting way to decorate the wardrobe is to cut out clusters of flowers from cretonne, glue them smoothly on the door panels, and varnish over them lightly. If cretonne hangings are used in the room, it is advisable to choose the predominating motive from a piece of the same material for the panel decorations, as carefully planned touches of harmony such as this always improve the general appearance of a room.—J. A. PARSONS.

Revolving Clothes-Dryer Collapses when Not in Use

THIS revolving clothes-dryer, which folds up when not in use, consists of a square support upon which slides a crisscross arrangement of four pieces of wood, put together as shown in the illustration below.

The four arms pivoted to this crisscross are supported by pieces hinged to the top of the post. The bottom of the post is



Removing the pin allows the arms to fold up against the post

rounded and set in a piece of water-pipe, which is sunk in the ground and rests on a piece of board. A steel ball inside the pipe, between the bottom of the post and the wooden base, serves to form a swivel joint.

To open the dryer, the crisscross is slid up and fixed in place with a pin.

I found that the one I made like this was just as good as the expensive ones on sale at local stores, and the total cost was about $1.50.—STANLEY ARMSTRONG.

Repairing Worn Runningboards

By G. A. Luers

(Contributed in the contest, "How I Made Money with My Tools")

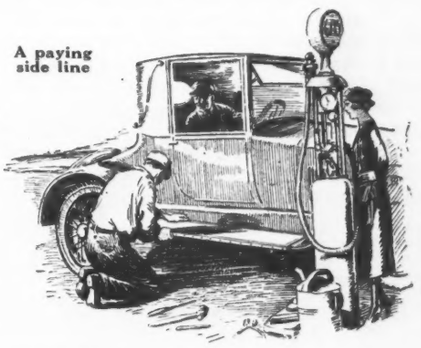
THE mechanically inclined owner of a small gasoline and oil filling station in the District of Columbia fills in the time during which he is not attending to the ordinary wants of his customers by renewing and installing automobile runningboards. He knew by observation that many cars either had holes through the runningboard linoleum, the molding torn away, or the wooden backing decayed or splintered, and he thought there would be money in making the necessary repairs.

For an initial trial he prevailed on the owner of a car that had been damaged in a slight collision for an order for new boards. Although both steps were worn and battered, he removed only the left step to serve as a pattern while the owner continued to use the car.

The preparation of this pair of stepboards proved a paying advertisement. The work was done in front of his small shop, and the completed boards, with their fresh green linoleum covering bound with polished bands of aluminum, attracted attention. As a result, practically all his spare time is utilized in fitting up one car after another with similar parts. By charging $1 an hour for his time, he adds from $3 to $4 to his daily earnings.

The materials used are strips of aluminum, molding, brown and green linoleum, 5-ft. lengths of oak boards planed on one side, glue, screws, and brads. The tool equipment consists of tin snips, ripsaw, small drill, auger, screwdriver and hammer.

The work is started by sawing the wood to the exact shape of the old board, which is used as a pattern. Holes are bored through for the bolts that hold the board to the brackets on the frame of the car. These bolts are placed in position, the face of the board is given a coat of glue, and the linoleum is spread on top. Next, the board is



A paying side line

placed face down and weighted until the glue has set. Meanwhile work on the other board is started and it is prepared in the same way. Both are left overnight to dry.

The next step is to trim the linoleum flush with the edge and tack it down. A long strip of molding is placed on one side of the board and drilled through for screws at 5-in. intervals. Snip out a small V at the corner and bend the molding around the corner, screwing it down and continuing all around the board. The inside edge does not need screws and can be fastened more quickly with brads. The attaching of the boards to the car is then simply a matter of placing the bolts in their respective holes and screwing on the nuts.

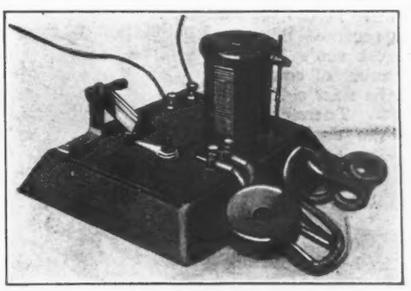
The success of this idea was not due so much to the mechanical ability of the service station owner as to his adoption of a special line of work that makes a direct appeal to car owners and counts heavily in improving a car's appearance. The work was done at a cost representing conservative charges. An equally good opportunity is afforded men in every community to "cash in" on this simple idea.

Safety-Razor Blade Replaces "Catwhisker"

By John H. Schalek

THE crystal detector illustrated has proved highly efficient in receiving broadcasted programs 53 miles from the Pittsburgh station KDKA.

The base is the ordinary 5 by 7 in. hard rubber developing tray. The detector unit makes use of a safety razor blade in place of the usual catwhisker. The tuning coil is wound on a wire spool originally used to hold 1 lb. of bell wire and contains 60 ft. of No. 24 enameled magnet wire. Tuning is accomplished by sliding up and down a vertical rod to which is soldered a bronze spring contact.



This crystal set receives 53 miles away from broadcasting station

The galena crystal can be adjusted so that any part of its upper surface may be placed in contact with the tip of the razor blade. By loosening and tightening the thumb-nut on the blade bracket, it is possible to regulate the pressure of the blade on the crystal, although this adjustment seems to be unnecessary, as the signals come in louder when the full weight of the blade is on the crystal. Whereas all catwhisker type contacts are very sensitive to even slight jars or shocks, it is almost impossible to jar this razor blade "catwhisker" out of contact.

How well signals come in can be judged by the fact that a horn cemented to the receiver made it possible to hear music nearly 2 ft. from the receiver.

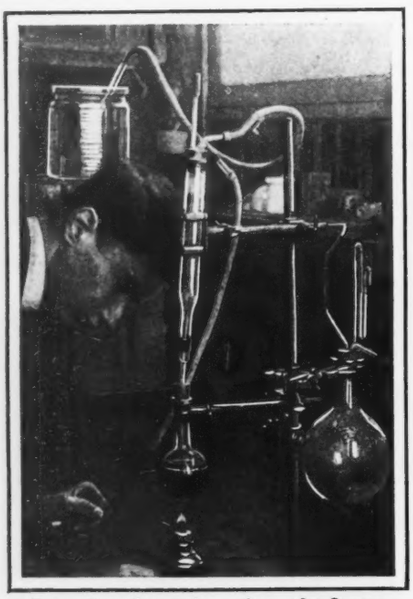
Nine playing cards were used in making the fixed condenser. After they had been dipped in hot candle grease, 8 strips of lead- or tin-foil used to wrap chewing gum were placed between the cards. Although this condenser was made in a few minutes and cost nothing, it gives excellent service. The discharge of a Ford coil through it was made as a test and has not, so far as I can see, affected its efficiency.

Note in the following pages the wide variety of valuable ideas for shop and metal working.

How to Make Your Own Perfumes from Flowers

THE chemistry of today extracts perfumes from many flowers and parts of other plants. In some plants, as in the mace and in the vanilla, the perfume is in the fruit; in oranges and lemons it is the rind that exhales a pleasant odor; in the florentine sword-lily it is the root; in camphor the wood, and in cinnamon the bark.

Even the animal kingdom contributes something in this search for perfumes. It offers musk and civet and many others.



Extracting the perfume from the flowers

Today most of our perfumes and essences are made artificially. They are in almost every respect identical with the natural products and are distinguished with difficulty from them. Although the laboratory furnishes us with the greater part of our requirements, the natural products are by no means neglected. They still form an important industry. But since some of the natural oils, as, for instance, attar of roses, are so expensive that they are almost prohibitive, other ingredients are used for the sake of cheapness. Since the yield from artificial products is far in excess of that from the natural substances, and since the artificial chemicals are so much cheaper, every one can secure his or her favorite perfume.

The making of perfumes from flowers is very simple when the proper precautions are taken. Such perfumes are not to be classed as artificial substances since they are made from flowers themselves and are therefore the natural product. There are many methods of making these perfumes in the laboratory.

A Home Laboratory Process

Take a glass flask, preferably of 8- or 16-oz. capacity, and fill it to neck with flowers that give off an odor. The stronger the odor, the more sure the result, although the most delicate odors can be caught when care is taken. Then fill the flask two thirds to three quarters full of ethyl alcohol, swing it around in the flask until all of the flowers are covered. Then place it in a water bath or place a small alcohol flame under the flask and extract with an upright or reflux condenser. This should be continued until the alcohol has boiled 8 hours.

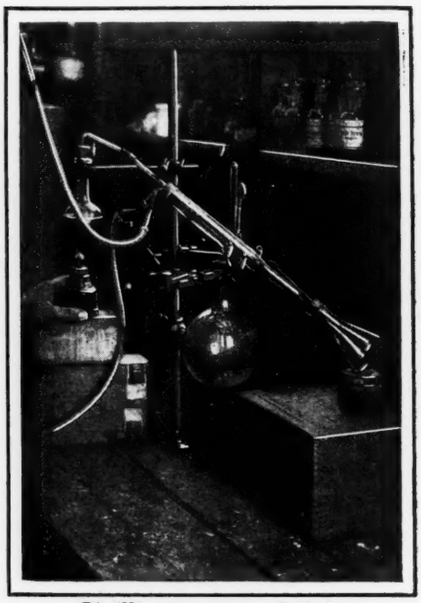
If it is not desired to extract, the flask with the flowers and the alcohol can be left standing a few weeks until the oil in the flowers has been absorbed by the alcohol. But this is not so effective a method as that of extraction.

After extracting, the flask should be cooled and the contents filtered either through filter paper or through a wad of absorbent cotton to remove the spent flowers. When all the liquid has been filtered, the flowers should be pressed to remove all surplus moisture.

Then the alcohol is to be carefully distilled. This can be done quite effectively by slightly lowering the pressure within the flask through suction and increasing this suction as the liquid distills. As a rule, about one ounce of the liquid should remain; this residue is the perfume.

Great care must be exercised when distilling. Not only because the distilling of alcohol requires care in itself, but because the oil extracted from the flowers burns readily when the temperature rises too high. This is avoided when the pressure in the flask is lowered, which causes the alcohol to distill at a lower temperature.

If a drop of the perfume, when placed on a piece of cloth, rapidly loses its odor, not enough alcohol has been extracted; more should be distilled. If this is not desired, then more of the same flowers must be plucked and placed in the flask, the distilled alcohol replaced, and the entire contents again extracted. But it is always advisable not to distill too often, as this increases the chance of burning the oil while the alcohol is being distilled. It is more satisfactory to use a second and even a third crop of flowers after filtration and extracting again



Distilling to remove alcohol

Answers to Sam Loyd Puzzles Appearing in August Issue and June Prize-Winners

DIVIDING A COW HERD

Let us call the youngest son's portion X cows, and the entire herd 7X, since the seven couples received like allotments. The youngest son's lot represents 8/9 of the number of cows from which the wife of the next elder son subtracted her ninth. Therefore that wife's share would be equal to $\frac{X}{8}$ and her husband's share would be $\frac{7X}{8}$. Since the youngest son's share exceeded his next elder brother's by 1, we have the equation:

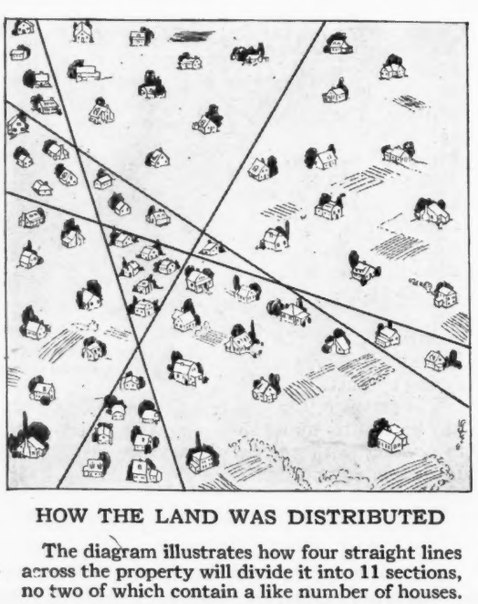
$\frac{7x}{8}$ plus 1 equals X, and X equals 8.

Then, 7X cows, the entire herd, must have consisted of 56 cows. The eldest son took 2 cows and his wife took 6.

THE MAGIC SQUARE REVERSED

3	2	7
8	5	9
4	6	1

Here we see how the nine figures of the Magic Square may be rearranged, without disturbing the central 5, so as to produce eight sums as required.



HOW THE LAND WAS DISTRIBUTED

The diagram illustrates how four straight lines across the property will divide it into 11 sections, no two of which contain a like number of houses.

WINNERS of Prizes for the best solutions of the puzzles appearing in the June issue are:

FIRST PRIZE, Ten Dollars: Emily Carmichael, Mobridge, S. Dak.

SECOND PRIZE, Five Dollars: Gertrude B. Chestresmith, Brooklyn, N. Y.

Ten One-Dollar Prizes:

Alexander Greenberg, New York City; F. K. Baxter, Jr., Fullerton, Calif.; E. B. Escott, Oak Park, Ill.; G. Malcolm Oldham, Elm Grove, W. Va.; H. G. Montgomery, Jr., Ross Field, Arcadia, Calif.; W. H. Elkins, Topeka, Kans.; Mary Quillian, Greenville, Ala.; Wiley M. Fuller, Washington, D. C.; B. S. Crandall, New London, Conn.; Willard Emick, Scranton, Pa.

HONORABLE MENTION

Solvers who are deserving of special commendation for their work in the June contest:

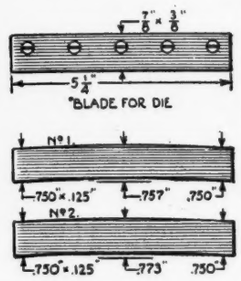
A. G. Kalbach, Grand Rapids, Mich.; Geo. A. Viehmann, Princeton, N. J.; Wm. G. Savadge, Wilkes-Barre, Pa.; A. Piplat, Sea Cliff, N. Y.

Vise Used in Hardening to Prevent Excessive Warp

MACHINISTS and tool and die makers will sometimes find it practical to keep steel from warping in the hardening process by clamping it in a vise.

A sectional die was sent to our toolroom recently with one of the sectional blades too soft because it had been ground down to about ⅛ in. of its usefulness. The die was needed as soon as possible, so I thought I would harden it. When I tried hardening it in oil, it was too soft, so I hardened it in water. It came out far from parallel and I was about to grind it and use shims when I happened to see on my bench a vise used for drilling. The idea then occurred to me to heat the piece, put it quickly in the vise, and dip vise and all in a barrel of water. I was more than surprised at the result, because the piece looked nearly perfect, and in ten minutes the die was ready to go back on the press.

To test further, I made and heated a pair of ⅛ by ¾ by 5 in. parallels. Number 1 was only .0005 in. out of parallel the ⅛-in. way and .0007 in. out the ¾-in. way. I purposely overheated No. 2, which was .002 in. out of parallel the ⅛-in. way, and .023 in. the ¾-in. way. The grade of steel was Jessop's.

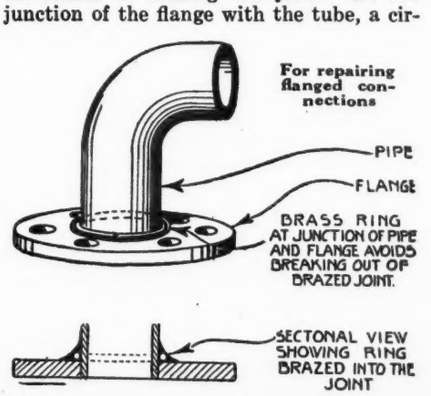


The blade and two test pieces

These pieces were made merely for experiment, as I always have had trouble in hardening such parts. It was surprising, too, that the parallels were hard all over. I thought they might be too soft on the surfaces that came in contact with vise jaws.—S. L. ROBERTS.

Reinforcing a Brazed Joint with a Brass Ring

A FLANGE connection for a tubular part having broken off at the joint, a method of reenforcement was devised that greatly increased the strength of the joint without adding to the cost or increasing the difficulties of brazing the joint. At the junction of the flange with the tube, a circular brass wire ring was set on previous to brazing. The brazing was carried out in the usual manner, that is, putting on the spelter and applying the heat.


For repairing flanged connections
PIPE
FLANGE
BRASS RING AT JUNCTION OF PIPE AND FLANGE AVOIDS BREAKING OUT OF BRAZED JOINT.
SECTIONAL VIEW SHOWING RING BRAZED INTO THE JOINT

The wire ring being brazed solidly in place, formed a shoulder which was stronger than the adjacent metal. Tank connections, manifolds, and similar flanged parts may be repaired in this way.—G. A. L.

Reversing Tap Chuck Speeds up Small Work

By Harry D. Parker

THIS simple tapping chuck has a friction drive that will slip before the tap breaks, except in the very small sizes, and it also has a high-speed reverse motion. The materials for making it cost less than $3, while the similar commercial attachment sells for about six times as much.

The friction members (*D* and *E*) are turned on a lathe (or in a vertical drill press if a lathe is lacking) from 1½-in. round fiber rod. These cone clutch parts are fastened to the drive spindle (*C*) and tap spindle by through pins. The drive spindle may be straight or a Morse taper No. 1 or No. 2, according to requirements. The tap chuck (*B*) is an ordinary commercial chuck, although one may be made from parts of a discarded breast drill.

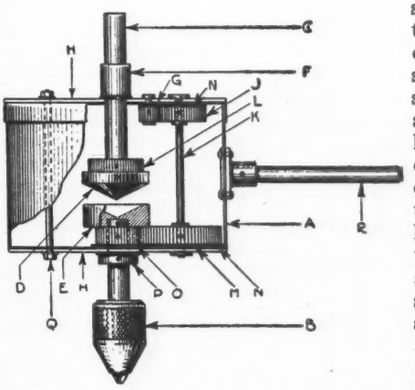


Diagram of the friction drive and gearing

The housing (*A*) in this case was made from a round tin in which a well known brand of mops is sold, but one slightly heavier in gage and smaller in size would have been better. The top is held to the housing by three through bolts (*Q*), which also hold the top and bottom ⅛-in. reinforcing plates (*H*).

Figure *F* is the spindle guide brazed to the upper reinforcing plate; *G* the intermediate gear, running free on a stud; *J* a 20-tooth drive gear; *K* the reverse shaft, pinned to its gears; *M* a 30-tooth gear; *N* a sheet of 1/16-in. fiber between the gears and the top and bottom of the housing; *O* a 15-tooth reverse gear, pinned to the chuck shaft; *P* the chuck shaft collar—a sheet of fiber separates it from the housing bottom. *R* is the handle that serves to hold the housing from turning.

All the driving stresses are direct through the drive spindle clutch and chuck spindle. The torsion is slight on direct drive and is taken up by the handle. On lifting the drill spindle at the end of a tapping operation, the drive spindle also is lifted, disconnecting the clutch members, and the tap stops instantly. The drive spindle speed should be about 50 revolutions a minute. The housing handle should rest against the drill upright at the time of reverse. As the drive spindle rises, the gear *L* engages the intermediate gear (*G*) and drives the reverse at high speed.

The greater the angle of the cones, the greater the torque before slipping occurs; about 25 degrees is ample for taps up to ¼ in. A friction drive of 2 in. in diameter will serve for taps up to ½ in.; as designed, the attachment will handle up to ¼ in.

Large Steady Rest Has Bearing of Babbitt

By James Ellis

THERE are times when the small shop must handle work that is really too large for its equipment, and additions must be quickly made. An example of this class of work is turning large shafts and other heavy pieces that must be firmly supported in a steady rest.

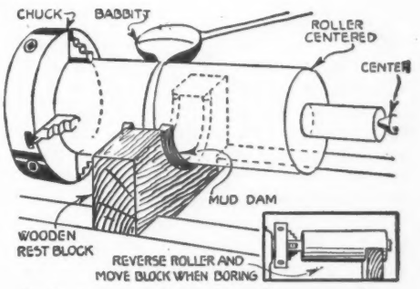
Not long ago we had a job in the shop far too large for any of our steady rests. It was a large roll used in a cottonseed-oil mill to crush seed. The shaft on one end had broken off and that end had to be bored out and a new shaft pressed in.

The usual method of handling would have been to make a wooden steady rest to fit the ways of the lathe and then clamp the wooden rest to the lathe carriage and bore it out to fit the job to be turned. We made the block in the usual manner, but instead of allowing some stock to bore out, we sawed out the circle about 1 in. larger in radius than the roll.

Takes Less Time to Make

The end of the roll which had been broken was trued up in the lathe chuck while the good end was supported by the center. The steady rest was placed under the roll and a mud dam built to make a mold so that a bearing of babbitt could be poured in. When this cooled, the roll was taken out and turned around, while the steady rest was moved out to support the end of the roll that had to be bored.

By using this babbitt lining we saved considerable time that would have been used in boring out the wood and, what is more important, obtained a much better steady rest. The babbitt does not wear like the wood rest and it is not necessary to put sheet metal liners in the bearing to take up for wear, which is generally required when wood bearing is used.



An improvement on the ordinary wooden steady rest

Another advantage is that once the wood block is cut out to shape, it is very little trouble to take out this babbitt liner and cast another for a different sized job. If desired, these liners may be retained to take care of possible future needs.

Carbon Cores Used in Welding

IN WELDING I have found old dry battery carbons useful for plugging holes that I wish to keep from filling up with the molten metal.

I have used them to good advantage in building up broken teeth in small gears. The carbon was shaped to fill the spaces between the broken teeth, and these spaces then were filled up with metal in the process of welding.—CHESTER CARPENTER.

How to Make Bushings of Standard Pipe

By W. F. Schaphorst

IT IS a good thing to know that bushings can be made out of standard pipe. Many pipe-fitters don't know that it can be done. Or, if they know that it can be done, they don't know the correct size of drill to use for tapping. I have occasionally made bushings out of pipe, but each time I found it necessary to first look into my handbook for the drill size to use and that is so much trouble that it is frequently easier to go to the store and buy a new bushing.

Sometimes, in the smaller towns, it is impossible to buy bushings in stores, on account of the small demand and the numerous sizes of pipe-fittings; hence I feel that the following information should be of value. I have collected all of the data together for all bushings that can be made out of ordinary sizes of extra heavy and double extra heavy piping.

To bush from ¼ in. to ⅛ in., for example, get a piece of ¼-in. extra heavy pipe sufficiently long for cutting the outside thread. Then cut off the end to the desired length, drill or ream with a 21/64-in. drill (diameter of drill 0.328 in.) and then tap with a ¼-in. pipe tap.

The table tells the complete story for all ordinary sizes.

Note that in one case, ⅜ in. to ¼ in., the internal diameter of ⅜-in. extra heavy pipe is such that no drilling is necessary.

Also note that in bushing from ½ in. to ⅜ in., either extra heavy or double extra heavy piping can be used.

To Bush from	*Use this Size of Pipe*	*Use this Size Drill or Reamer*
¼ in. to ⅛ in.	¼ in. extra heavy	21/64 in. drill = 0.328 in.
⅜ in. to ¼ in.	⅜ in. " "	none
½ in. to ⅛ in.	½ in. double extra heavy	21/64 in. drill = 0.328 in.
½ in. to ¼ in.	½ in. " " "	27/64 in. drill = 0.422 in.
½ in. to ⅜ in.	½ in. " " "	9/16 in. drill = 0.562 in.
½ in. to ⅜ in.	½ in. extra heavy	9/16 in. drill = 0.562 in.
¾ in. to ⅜ in.	¾ in. double extra heavy	9/16 in. drill = 0.562 in.
¾ in. to ½ in.	¾ in. " " "	11/16 in. drill = 0.688 in.
1 in. to ¾ in.	1 in. " " "	29/32 in. drill = 0.907 in.
1¼ in. to 1 in.	1¼ in. " " "	1⅛ in. drill = 1.125 in.
1½ in. to 1 in.	1½ in. " " "	1⅛ in. drill = 1.125 in.
1½ in. to 1¼ in.	1½ in. " " "	1-15/32 in. drill = 1.468 in.
2 in. to 1½ in.	2 in. " " "	1-23/32 in. drill = 1.72 in.
2½ in. to 2 in.	2½ in. " " "	2-3/16 in. drill = 2.187 in.
3 in. to 2½ in.	3 in. " " "	2-9/16 in. drill = 2.562 in.
3½ in. to 3 in.	3½ in. " " "	3-3/16 in. drill = 3.187 in.
4 in. to 3½ in.	4 in. " " "	3-11/16 in. drill = 3.688 in.
4½ in. to 4 in.	4½ in. " " "	4-3/16 in. drill = 4.187 in.

Useful Shop Truck and Portable Bench

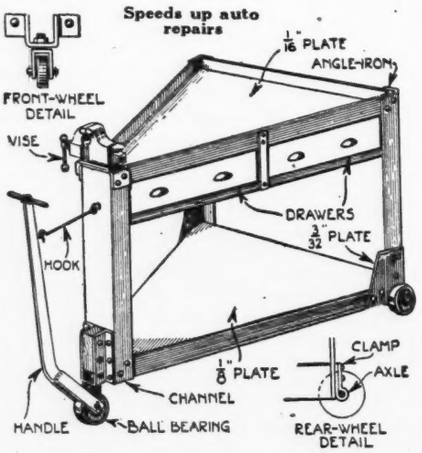
By P. P. Avery

A HANDY shop truck that will move at a mere touch may be made with old ball or roller bearings.

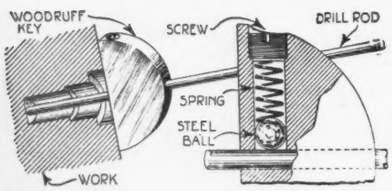
Build a triangle frame as shown, 30 in. high, and 30 in. from front to back along the center line. Offset plates are provided for the wheels. The front one swings on a 1-in. bolt and has a 1-in. forked rod handle. The support for the drawers is 5 in. below the top plate, so that the drawers provide ample room for working tools. Large parts, motors, etc., can be laid on the bottom platform and easily carried to any part of the shop.

Wherever convenient, use 3/16-in. rivets in constructing the truck. In other places, use bolts, lock washers, or double nuts.

When the truck is complete, give it a good coat of metallic paint.



Self-Setting Depth Gage Has no Screw Adjustment



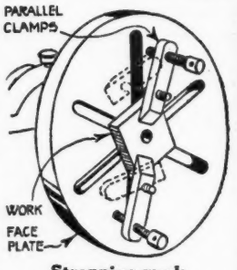
THE depth gage illustrated, I find to be very useful where a depth gage is much used because it requires no screw for tightening the head. It also has the advantage of not shifting on the rod, as those that are tightened with a screw often do when they are being set.

A piece of ⅛-in. drill rod is passed through a ¼- by 1½-in. Woodruff key and a 3/16-in. steel ball is pressed against the rod, as shown, by a spring and headless setscrew.—JOHN AURES.

WHEN new files are to be used upon narrow surfaces of hard metal, it is advisable to use oil or even to fill the teeth with oil and chalk. Oil also helps in finishing wrought iron or steel with fine files, as the work is not so likely to be scratched.—C. F. M.

Making the Most of Machinists' Parallel Clamps

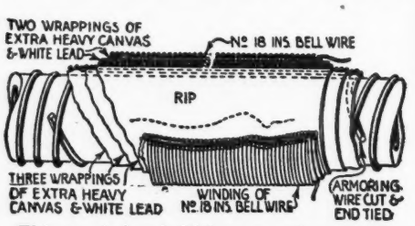
THE exceptional versatility and usefulness of the machinists' and toolmakers' parallel clamp rival that of the carpenter's hand screw. The illustrated method of strapping small work to the faceplate of the lathe is handy to know. The clamp serves the purpose of a strap, bolt, and blocking. The loose or unthreaded jaw is placed on the back of the faceplate and the other jaw is used on the front.—CHARLES H. WILLEY.



Strapping work to faceplate

Emergency Repair for Steam Hose

IN A central station of 3000 horsepower about 150 ft. of 1½-in. steam hose is used to blow out combustion chambers and around upright water tube boilers. The steam pressure of the nine boilers depends on having clean tubes and economizers, as only one boiler at a time can be spared for repairs.

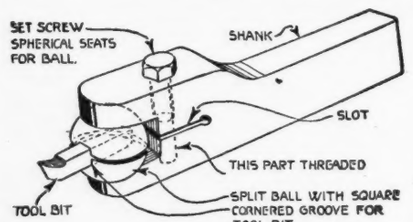

TWO WRAPPINGS OF EXTRA HEAVY CANVAS & WHITE LEAD
No. 18 INS. BELL WIRE
RIP
THREE WRAPPINGS OF EXTRA HEAVY CANVAS & WHITE LEAD
WINDING OF No. 18 INS. BELL WIRE
ARMORING WIRE CUT & END TIED
This repair has held for more than a year

One night the hose let go in three places. I made an emergency repair by cutting away the wire wrapping on the outside of the hose, opening the rips and daubing the ragged edges with a generous supply of white lead, and wrapping on the outside three layers of heavy canvas, which I also smeared with white lead on both sides. Next, I wound on No. 18 bell wire; then applied two more wrappings of doped canvas and bell wire.

After drying, the hose went into service again, standing 165 lbs. steam pressure, and after one year it still remains in regular use.—W. L. JOHNSON.

Improved Lathe Tool Holder

THIS lathe tool holder, which has certain advantages because of its flexibility of adjustment, consists of a body or shank machined as shown. It has two spherical seats cut in the jaws to take a ball that is split in half. Each half has a square cornered groove milled in it to suit the usual small high speed steel tool bit. This arrangement permits the cutter to be set quickly at various angles.—W. BURR BENNETT.



Permits wide range of tool adjustments

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MAGNAVOX Radio
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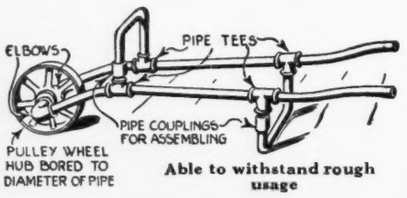
BETTER SHOP METHODS

Pipe and Pipe Fittings Make Sturdy Wheelbarrow Frame

A STURDY wheelbarrow frame that will stand unusual abuse without damage may be made of pipe and pipe fittings. The one illustrated, which was



Able to withstand rough usage

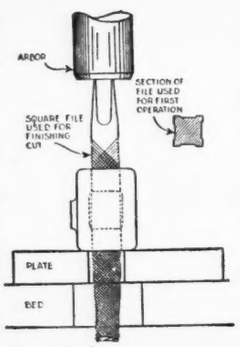
built in a plumbing shop, has a flanged pulley for a wheel.

Aside from cutting the pipe and threading the ends, the only work required was that of boring out the pulley hub. Since the barrow was to be used for carrying steel pipe, drums, and plates, no body was attached. It would be a simple matter, however, to attach a body of sheet-iron or wood.—G. A. LUERS.

File Serves as Substitute Broach

FILES may sometimes be used for broaching standard size holes in place of the usual expensive broaches. An example of this cheap method of broaching is illustrated.

The casting shown is a slide for a ½-in. bar. It has a cored hole with the central surfaces relieved so that only the two ends have to be finished. This had been done by filing until a workman discovered that he could drive a ½-in. square file through with an arbor press. This left a smooth hole.

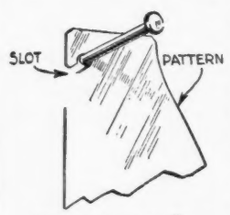


Finishing a square hole

Using two files proved to be an improvement. The first was prepared by grinding the teeth away as shown in the small sectional detail, and the regular square file made the finishing cut. It was found that 75 holes an hour could be "broached" in this way.—S. A. MCDONALD.

Hanging Sheet-Metal Patterns

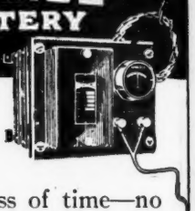
IN shops where sheet metal is handled, more or less trouble is experienced with patterns such as are used for elbows, skylights, ventilators, and the like. If a hole is punched in the patterns and they are hung on a nail or wire, it usually happens that a number have to be removed before the pattern desired can be taken off.



Patterns are easily removed

To remedy this, my idea is to cut a slot up from the edge to the hole already punched. In this way the needed pattern may be slipped on and off without disturbing the others.—S. W. SANDERS.

HOMCHARGE YOUR BATTERY for A Nickel



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Easily Made Dendrometer Measures Heights

By Capt. E. A. McCann

WITH this simple little instrument it is possible quickly and accurately to measure the height of trees, buildings, and other tall objects. To make it, obtain a square board. A convenient size is 16 in. square. For the best results the board should be prepared like a drawing-board with battens to keep it from warping. On it draw a square—*a, b, c, d*—15 in. each way. Divide each side into 15 equal parts and rule off 1-in. squares. Mark each square to represent 10 ft. as in Fig. 1. Either bore a small hole *c* lengthwise through what is to be the top edge of the instrument, or, better still, clamp a small tube *f* to the edge, making sure that it is parallel to *d*.

The board is mounted on a post about 6 ft. long (Fig. 2), with a sharp point or base of some kind, so that it can be driven into the ground or stood upright when the instrument is being used. Bore a hole through the top corner of the board *g* and through the top of the post, and fasten the two together with a long thumbscrew or "tonk" to keep the board clamped at any angle. From the corner of the ruled square marked *h*, suspend a plumb line. The instrument is then complete.

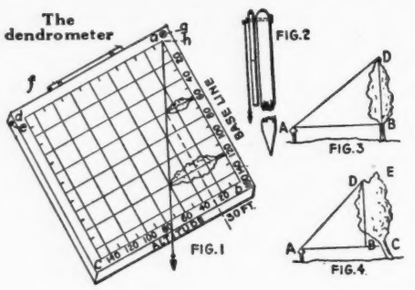
Instead of drawing the squares on the wood, they can be marked on paper or cardboard and glued to the board, which may be of any size, provided it is divided into equal squares.

How to Measure an Object

To measure an object with the dendrometer, such as the tree shown in Fig. 3, measure off a suitable base line, as *AB;* set up the post at *A* and then sight the top of the tree through the tube *f*. Clamp the board in that position. The point where the plumb line cuts the ascertained base line will show the height of the object as indicated on the altitude scale. This is much simpler than it sounds and a study of the drawing will quickly reveal how the instrument works. For instance, if the base line *AB* is 60 ft. long, the distance *BD* will be 30 ft. if the top of the tree is sighted at the angle shown in Fig. 1. If the base line happens to be 120 ft., the relation would be as shown by the larger tree in Fig. 1, and the height would therefore be 60 ft.

This gives a height from the level of *A* to the top and not from the ground level. If the ground is uneven, you can sight this point first by looking through the tube while the plumb line lies along *ab*.

It should also be noted that the base line is measured to a point vertically under the highest visible point, as *AB* in Fig. 4 and



not *AC*. The ascertained height is *BD* and not *BE*, although *E* happens to be higher than *D*.

The principle upon which the instrument works is that of proportional triangles. It will be seen that the angles of *ABD* would be the same in any actual case of measurement as those of the small triangle formed by the distance along *ab*, which represents the known base line, the distance from the lower end of that base line to the plumb line taken in a direction parallel to *ad*, and the plumb line from the last point back to *a*.

Therefore the base line of the small triangle must bear the same relation to the leg which is at right angles to it as the actual baseline *AB* bears to the vertical line *BD* representing the height of the tree. Since *AB* equals 60 ft. (in the first example), the base line of the small triangle represents 60 units and the leg at right angles to it, being in the same proportion to *BD*, can be measured in the same units and is, in this instance, 30.

$10 and $15 Are Offered Monthly for Useful Mechanical Ideas

AS A bonus for especially useful ideas contributed to The Home Workshop each month, POPULAR SCIENCE MONTHLY gives a first prize of $15 and a second prize of $10. These awards are in addition to the usual space rates.

Every man who works with tools has at some time or other hit upon methods of construction that were particularly good; or made something that was unusually serviceable or valuable. These "best ideas" are exactly what home workers are interested in. Therefore write briefly, illustrate with pencil sketches or photographs, and send to the Home Workshop Editor. Those accepted will be purchased at the regular space rates and will be eligible for the "Best Idea" prizes.

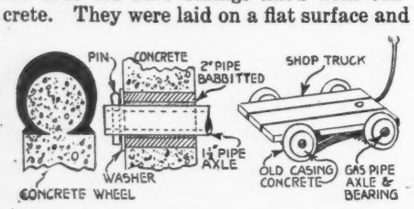
The prize-winners for September are:

FIRST PRIZE, $15: **George A. Luers**, Washington, D. C. "Bench Vise for Carpenter Has Wide Range of Adjustment" (see page 108).

SECOND PRIZE, $10: **S. A. McDonald**, Brooklyn, N. Y., "File Serves as Substitute Broach" (see page 80).

Old Auto Shoes with Concrete Filling Used as Truck Tires

THE wheels of this shop truck, which was designed by the foreman of a large shop who disliked the noise made by steel tires, are four old auto casings filled with concrete. They were laid on a flat surface and



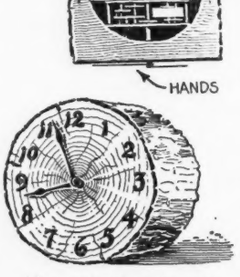
The wheels on a shop truck made less noise than steel tires and gave good service

filled with a rich cement mixture with the exception of the center, where lengths of 2-in. pipe were inserted to serve as bearings.

It took a little time and care to center the bearings and locate them perfectly plumb, but the finished wheels proved entirely satisfactory. The additional weight of the concrete was not noticeable, and noise was eliminated.—DALE R. VAN HORN.

Making a Rustic Clock

A RUSTIC clock for the home, hunting lodge, or summer camp may be made from a carefully selected section of tree trunk. Smooth one end to serve as the face and tack brass numbers on it. Drill a hole through the center and gouge out sufficient space in the back to permit the insertion of the works of an alarm clock.



If necessary, a rod and tube may be used to extend the minute and hour-hand spindles. A wooden back should be fitted carefully and screwed on to protect the works from dust, and you will then have an article both useful and goodlooking.—J. B. MORAN.

Alarm clock works set in a log

READERS of POPULAR SCIENCE MONTHLY who have followed Home Workshop Blueprint No. 6 in making a radio set are reporting exceptionally fine results. Extracts from the letters are given below.

I received the blueprint, "Radio Receiving Set with Two Stages of Amplification," from your department and used it and the instructions on page 75 of Vol. 100, No. 5, to build a receiving set. I omitted the two amplifiers and the variable condenser. With the set I am able to get Schenectady, N. Y., very plainly whenever I try to tune them in. Do you consider this exceptional for a set having no amplifiers? I also get Detroit, Mich., Indianapolis, Ind., Kansas City, Mo., and many other distant stations. My aerial is 35 feet high and consists of three wires 80 feet long.—VICTOR C. BEETOW, Elkhorn, Wis.

About two months ago I constructed a detector set as per your blueprints, and must say that I have got wonderful results. KDKA at Pittsburgh comes in so strong that I separate the head phones and two can listen in very easily. But I think it remarkable how plainly I get Newark, N. J., Springfield, Mass., and Schenectady, N. Y., without amplifiers.—HENRY JARRETT, Moundsville, W. Va.

I made a set according to your blueprint and have had some wonderful concerts from Schenectady, N. Y., Newark, N. J., and Springfield, Mass. It is wonderful, it is perfect.—EDWARD DORNSIFE, Shenandoah, Pa.

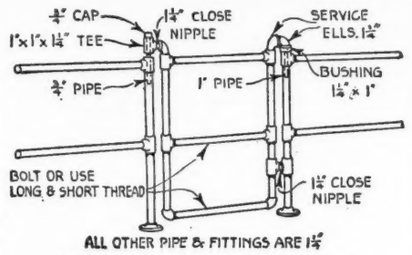
The fact that Mr. Beetow is able to hear concerts given at Schenectady, N. Y., in his home at Elkhorn, Wis., 685 miles away, without using any amplification in summer, when the carrying strength of signals is at its lowest point, is sufficient indication of the range and sensitiveness of the set when properly made and operated. Other distances mentioned are also noteworthy—Springfield, Mass., to Moundsville, W. Va., 440 miles, and Springfield, Mass., to Shenandoah, Ia., 225 miles.

To order one of the blueprints, use the coupon on page 86.

THE HOME WORKSHOP

Strong Gate Is Made of Pipe and Fittings

PIPE and pipe fittings form this strong, serviceable gate. It will be found useful in many places, especially for guarding small-sized elevator shafts, well holes in the



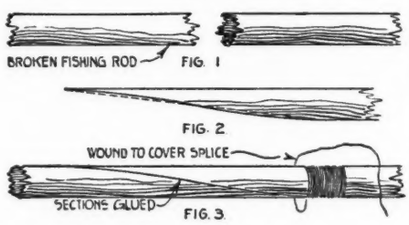
Useful for guard railings inside and outside the shop

floor of a shop, and openings in outside fences that are made of pipe.

The hinges are so arranged that the gate may be swung in or out, whichever is most convenient. This is frequently an advantage when heavy crates have to be handled in close quarters. The lock is nothing more than a length of ¾-in. pipe that passes through tees in the gate and the guard-rail post.—ROSS W. MORRISON.

Mending Broken Fishing Rods

BROKEN fishing rods, either of the split bamboo or solid wood varieties, may often be repaired by splicing the parts. If the break is like that shown in Fig. 1, the ends should be trimmed to an angle such as



Curving the splice a little makes it stronger

shown in Figs. 2 and 3. It will be noticed that the cut is curved a trifle, as shown in Fig. 2.

When a perfect fit has been obtained between the two parts, glue them together and hold them in a clamp of some kind until thoroughly dry, then wind the splice with silk used for wrapping fishing rods.

This method of repair is particularly valuable when a rod is broken during a camping trip, far from a sporting goods store.—R. L.

Using Broken Jack-Knife Blade

HAVING broken the large blade of my jack-knife, I ground the stub off in such a way as to leave a part of the thick back edge projecting to form a small screwdriver. The thinner edge was ground square with a sharp corner and it serves as a scraper. I have been surprised how well this sharp, square corner cuts around the edges of tin cans, and frequently I use it in starting an opening for tin shears when cutting off sections of pipe.

A semicircular notch was made in the sharp edge as near the handle as possible; it is convenient for scraping insulation from wires.—E. M. SHELTON.

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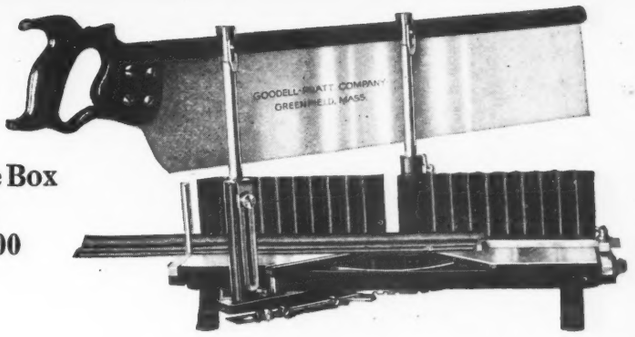
1500 GOOD TOOLS



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Mitre box illustrated is made entirely of steel and is unbreakable.

Truss frame strongly riveted, insuring absolute accuracy.

Saw can be swung from 45 to 90° degrees, right or left.

Steel bottom plates scored to keep work from slipping.

Mr. Punch Says:

"Men, here is a Mitre Box as true as your best friend!

"It lets you make a clean, thin cut at any angle you want. It holds rigid the piece of wood you're working on, and it *couldn't* splinter it even if it wanted to. When your job's done, the edges are smooth and true."

This Goodell-Pratt All Steel Mitre Box is trussed like a steel bridge. Saw can be locked at any angle and is held by a spring which can be released by a slight downward pressure. Stops are easily regulated to permit sawing to any desired depth.

You don't buy tools very often. When you do, you expect them to last a long, long time. That is why it is so well worth your while to remember Goodell-Pratt 1500 Good Tools—it's a name that stands for all that's trustworthy and accurate in tools.

Skilled workmen, toolsmiths of long experience, using the highest-quality materials obtainable, working in one of the most modern tool-making plants in the world, do everything in their power to make tools for you that you are glad to own and proud to work with.

The more cranky you are about the tools you use, the better you'll like Goodell-Pratt 1500 Good Tools. You will find them at those hardware dealers where high-grade tools are known and appreciated.

Write for free booklet showing hundreds of different tools for carpenters, mechanics, artisans and home "putterers" who take pride in what they can do with their two good hands.

GOODELL-PRATT COMPANY

Toolsmiths

Greenfield, Mass.

The Radio Headset Sensation of the Year

ALMOST over night the new Manhattan Radio Telephone Headsets became famous. Since the first headset was produced on March 20th, over 130,000 have been made and sold; made with the precision of a watch and demanded by professional operators and amateurs who know.

The Manhattan Radio Headset is not just "another" headset on the market, but a product designed and built by one of the oldest radio manufacturers. Only in the higher priced instruments do you get the same supersensitiveness, the same amplifying qualities and the same freedom from distortion that are found in Manhattan Radio Telephone Headsets; and at a price within reach of all amateurs.

Outstanding features of the new Manhattan Radio Telephone Sets

Extreme Sensitivity
Amplifying Qualities
Freedom from Distortion
Sanitary Head Band with friction grip adjustment
No Hair Catching Obstructions
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Manhattan Radio Telephone Headsets are on sale by all reliable radio dealers. If he hasn't them in stock he will get them for you.

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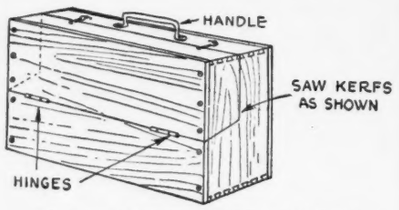
Look for this distinctive box on the dealers' shelves. Look for the M-Seal-Flash—

that is on the back of each receiver case of genuine Manhattan Headsets.

THE HOME WORKSHOP

Strong Tool Kit Made from Shotgun-Shell Box

TO MAKE a small tool kit easily and cheaply, go to your hardware dealer and obtain a good shotgun-shell box. Measure up from the bottom 4⅞ in. and draw a line all around; then cut the top section off on that line. Take the bottom section and, turning it up on one of the sides, mark the ends as shown in the drawing. The vertical saw cuts in the ends are 4½ in. long, and the slanting cuts run up to them from points 3 in. from the bottom.



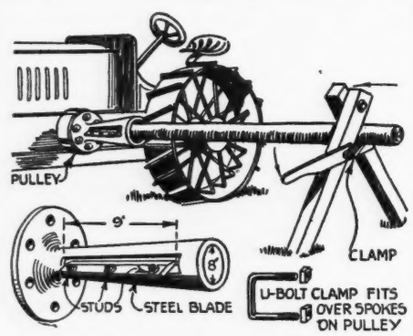
Fitted with hinges, catches, and handle

The next step is to nail or screw on the other side of the box and to hinge the lid. A handle and a pair of hooks or a lock will complete the box unless it is desired to place a small tray or two inside. The outside should be painted black, brown, or gray.—T. C. BUNCH, JR.

Farm Tractor Used for Sharpening Posts like Pencils

AS I watched one of my boys sharpening a pencil with a small thumb-twisting sharpener, I conceived the idea of attaching a similar device of a proper size to a farm tractor for sharpening the large number of fence posts and stakes required each year on the farm.

The lower part of an old cream separator was sawed off 14 in. above the circular base and a slot 9 in. long and 1 in. wide was cut out in one side by means of a drill and a hacksaw. Three angle lugs were used for attaching the steel blade used as a cutter. It was bolted on so that the cutting edge extended just beyond the inner surface of the conical casting.



A tractor provides the power for pointing fence posts

The base of this giant pencil sharpener was attached to three of the six spokes of the belt wheel of my tractor with three U-bolt clamps. Finding that I could not hold the posts by hand as they were being whittled off, I made a jack so that pressing down on the lever would clamp the post rigidly. Leaning the jack toward the tractor allowed the post to feed to the sharpener as the point was shaped. One man is able to point one cedar post a minute.—GEORGE G. MCVICKER.

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its Construction, Operation and Repair, Including the Fordson Farm Tractor, F. A. Lighting and Starting System, Ford Motor Truck, By VICTOR W. PAGE. 410 pp., 153 ills.
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The Modern Motor Truck

Its design, Construction, Operation and Repair. By VICTOR W. PAGE. Treats on all types of motor trucks and industrial tractors and trailers and considers all types of trucks, gasoline and electric, and all varieties of truck bodies. 800 pages, 750 illustrations. ***Price, $5.00***

Automobile Ignition, Starting

and Lighting, with Questions and Answers. By CHARLES B. HAYWARD, M.S.A.E. A comprehensive analysis of the complete electrical equipment of the modern automobile. 1,024 pp., 740 wiring diagrams and ills. (including 128 blueprint diagrams).
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Storage Batteries Simplified

Tells how to charge, care for and rebuild storage batteries. Also outlines their industrial uses, including how they are used in central station standby service, for starting automobile motors, and in ignition systems. 208 pp., illustrated. ***Price $2.00***

How to Run an Automobile

By VICTOR W. PAGE. Gives concise instructions for starting and running all makes of gasoline automobiles and how to care for them. Describes every step for shifting gears, controlling engine, etc. 178 pp., 72 ills.
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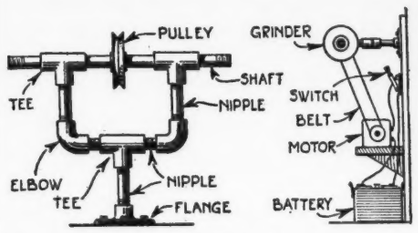
Popular Science Monthly
225 West 39th Street New York City

THE HOME WORKSHOP

Pipe Fittings Make a Cheap and Quickly Assembled Grinder

NO DOUBT many of my fellow readers have met with the same difficulty as mine—needing a power grinder but not feeling justified in buying one. I overcame this dilemma by constructing a bench grinder from pipe fittings, as shown in the accompanying sketch.

The grinder head was made from ½-in. pipe fittings. The tees were filled with



The grinder may be attached to bench or wall

babbitt and drilled to suit the shaft, which was threaded on both ends, right and left hand, for the hexagonal nuts used to clamp on the emery-wheels.

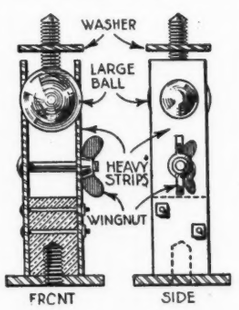
The motor used for driving this grinder was an old 6-volt starting motor. This I was lucky enough to own, but any one who has no power available can easily obtain one from an automobile wrecking company at a nominal cost. These motors run at very high speed and are also sufficiently powerful.

I found that this made a serviceable grinder and, of course, the cost was only a fraction of any power grinder on the market.—HAROLD N. WRIGHT.

Universal Holder for Cameras

WITH this attachment the amateur photographer will have no difficulty in placing his camera in many positions that would be impossible if an ordinary tripod were used.

A brass ball is gripped between two heavy steel strips, into the free ends of which two holes are drilled. A bolt with a winged nut is used to tighten the grip of the strips. The brass ball is tapped to receive a rod, the outer end of which is threaded to fit the camera socket. A washer is soldered to the screw in order that the camera will seat properly.



Permits tilting the camera in many positions

The brass block to which the strips are attached is also provided with a washer, and a hole is drilled up into this and tapped to suit the tripod screw.—J. B. MORAN.

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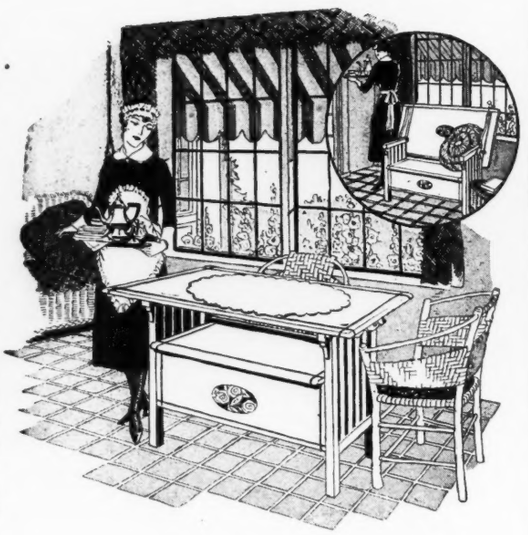
THE HOME WORKSHOP

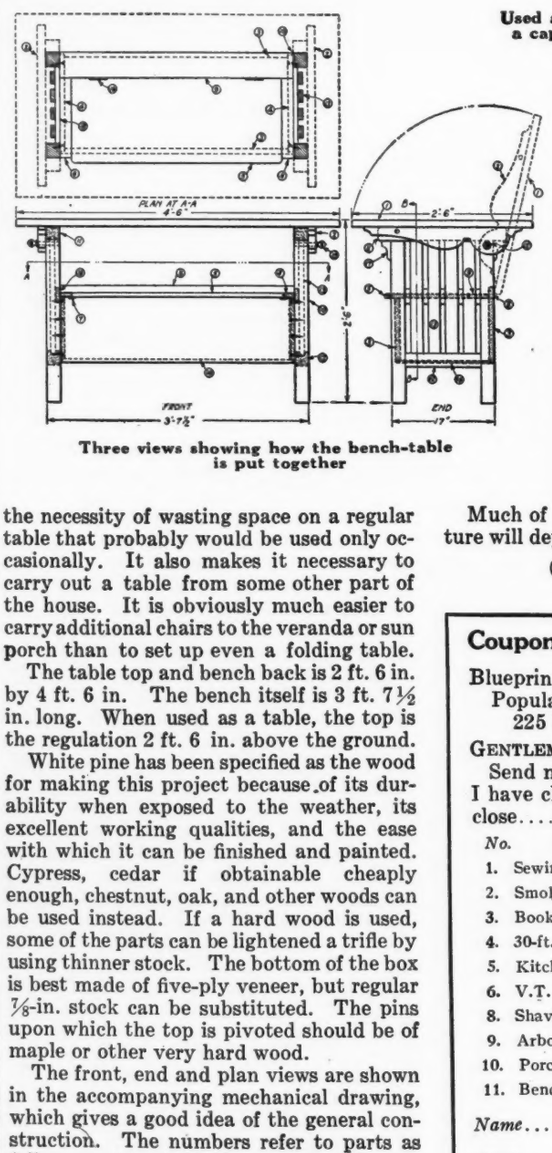
How to Construct a Bench and Tilt-Top Table for the Veranda or Sun Porch

THIS attractive combination bench, chest, and tilt-top table can be made at small cost and with little difficulty by men who have had a certain amount of experience in handling woodworking tools. It has just that mixture of utility and novelty that professional decorators use so effectively.

The piece is intended for use on the veranda or in the small sun porch that is included in the floor plan of so many modern homes. Primarily it is used as a bench, but when a table is needed, perhaps for a porch luncheon or games, the back of the seat is turned forward and rests on the arms of the bench, forming a table top. The advantage of this arrangement lies in the fact that a table is always at hand without the necessity of wasting space on a regular table that probably would be used only occasionally. It also makes it necessary to carry out a table from some other part of the house. It is obviously much easier to carry additional chairs to the veranda or sun porch than to set up even a folding table.



Used as bench or table. There is a capacious box under the seat



Three views showing how the bench-table is put together

The table top and bench back is 2 ft. 6 in. by 4 ft. 6 in. The bench itself is 3 ft. 7½ in. long. When used as a table, the top is the regulation 2 ft. 6 in. above the ground.

White pine has been specified as the wood for making this project because of its durability when exposed to the weather, its excellent working qualities, and the ease with which it can be finished and painted. Cypress, cedar if obtainable cheaply enough, chestnut, oak, and other woods can be used instead. If a hard wood is used, some of the parts can be lightened a trifle by using thinner stock. The bottom of the box is best made of five-ply veneer, but regular ⅜-in. stock can be substituted. The pins upon which the top is pivoted should be of maple or other very hard wood.

The front, end and plan views are shown in the accompanying mechanical drawing, which gives a good idea of the general construction. The numbers refer to parts as follows: 1, top of table; 2, cleats under top; 3, front and back of box; 4, ends of box; 5, lid of box; 6, lid fillings; 7, lid rests; 8, strip at back of box; 9, back box filling; 10, posts; 11, top of posts or arm; 12, bottom end rails; 13, end slats; 14, bottom of box; 15, pins; 16, hinges; 17, brackets; 18, strip at top ends of box.

A completely itemized bill of materials or cutting list, assembly views drawn to the scale of 1½ in. to 1 ft., and full size details of top, cleats, and section, box joints, pins, etc., are given on Blueprint No. 11, which may be obtained by filling out the accompanying coupon and sending it with 25 cents to the Blueprint Editor.

Much of the charm of this piece of furniture will depend upon the way it is finished.

(*Continued on page* 87)

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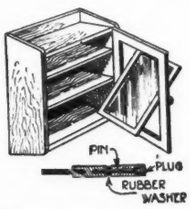
Constructing Bench and Tilt-Top Table

(*Continued from page* 86)

The best method, especially if it is to be used on an open porch, is to give it two or three coats of paint carefully selected in tint to match or harmonize with the woodwork near which the bench is to be placed. Stenciled ornaments on the front of the box and the bench back and possibly on the top may be used to relieve the plain surfaces; striping, if carefully done, will add to the attractiveness of the finish; or stenciling and striping may be combined. Brilliant colors, if chosen with discrimination, will be suitable for these decorations. A study of some of the better quality of similar commercial furniture will provide many good suggestions for style of finish and also for the ornaments.

Shaving Cabinet Fitted with Adjustable Mirror

A WIDE range of mirror adjustments is possible with this shaving cabinet, which can be made quite easily with the carpenter's tools found in the average home workshop.



Mirror turns in or out

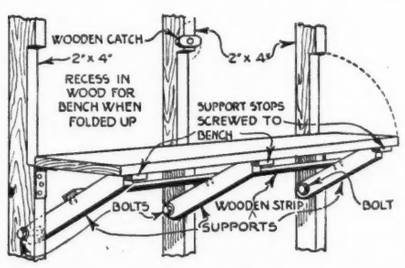
The mirror is pivoted by means of two pins that pass through the door stiles into the mirror frame. A commercial mirror already framed may be purchased if desired and the door adjusted to fit it.

By swinging the door and tilting the mirror, the best possible combination of light and reflection can be obtained. The door may be closed with the glass turned in or out; the mere closing of the door pushes the mirror neutral.—DONALD W. CLARK.

Collapsible Workbench Fits the Small Garage

MY GARAGE, like many others, was limited in size by the area I had to build on and by the weight of my pocketbook. Therefore, I did not have much room for even a small workbench, so I built a folding bench as illustrated.

The top, when not in use, is turned up and locked in the slot cut for it out of



The bench folds up when not in use

two by fours." The three supports, which are held together by a wooden strip, are dropped out of the way, and raised when the bench is needed. The bench cost very little to construct and it certainly has proved useful and convenient in the garage.—FRANK W. BENTLEY, JR.

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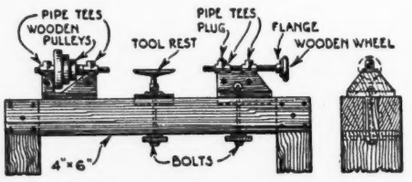
How to Make a Serviceable Lathe without Castings

A CHEAPLY constructed lathe for the home workshop can be made as shown in the accompanying drawing. The bed consists of two pieces of straight-grained, well seasoned wood 4 by 6 in., and as long as desired. The headstock block is of wood and the bearings are two drop tees. The tees should be oversized so that Babbitt metal can be poured into them to form bearing surfaces after the shaft has been fastened temporarily in place.

The tailstock, which also is of wood, has for its spindle a threaded pipe. It passes through two tees. The right-hand tee has the left-hand threads filed away and the left-hand tee has all the threads removed. The left-hand tee has a plug placed in the top of the left-hand tee for locking the spindle in place. The tailstock hand wheel is a wooden disk fastened to the spindle by means of a floor flange.



The headstock, tailstock, and bed are wood and the bearings are pipe tees

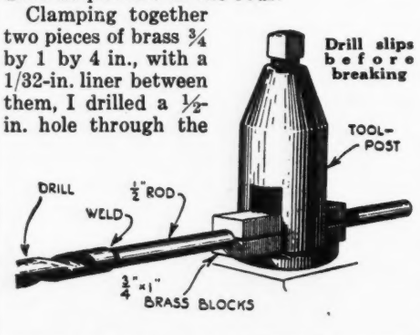
The toolpost is built mainly of pipe fittings. It is best to have the toolrest itself made by a blacksmith, who will not charge much for the work. The step pulley is made of three pieces of wood nailed together.—JONAS BYBERG.

Lathe Fixture Simplifies Drilling of Small Deep Holes

TIME can be gained and fewer drills broken in the drilling of small deep holes on a lathe if a drill guide is made and used as shown in the accompanying illustration.

I made use of this expedient when it was necessary to drill a number of connecting rods 44 in. deep. I was using a 9/16-in. drill welded to a long ½-in. rod. It was obviously to my advantage to break as few drills as possible in the rods.

Clamping together two pieces of brass ¾ by 1 by 4 in., with a 1/32-in. liner between them, I drilled a ½-in. hole through the center from end to end. Then I removed the liner and placed the blocks in the tool post of my lathe with the drill rod between them. I kept the screw just tight enough to hold the drill for cutting and yet allow it to turn in the blocks when it became chip bound. This prevented the drill from breaking in the work, and I had no mishaps through the entire job. A little experience will tell one just how tight to keep the screw in the tool holder to get the best results. It is, of course, necessary to make sure that the drill is exactly in line and level with the lathe centers.—GEORGE W. ELLIOTT.



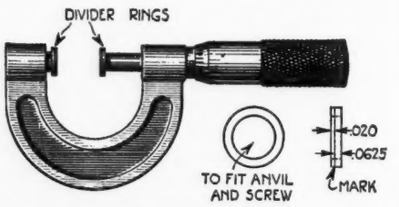
Blowout in Auto Tire Temporarily Repaired with Burlap

ON A recent automobile trip I stopped to assist a fellow motorist who had a blowout in one of his rear tires. I offered him the loan of a large blowout patch and anything else of use in the tire-repairing line, but he waved them all aside. Instead, he asked me if I would carry him to the next farm for some burlap. I did so, and we returned with a burlap bag that he immediately cut up into strips about 3 in. wide. Then starting to wind a strip about a partly inflated tube, he continued to wind the burlap back and forth for a distance of about a foot, winding on several layers. Lastly he laid a pad of burlap inside the casing over the hole. Then, inserting the tube in the casing with the two burlaps meeting, he put the casing on the wheel and pumped the tube.

I invited him to follow me into camp for that night, a distance of nearly 60 miles, and he reached there in prime condition. The tube was uninjured and the burlap padding was still holding its own.—L. B. ROBBINS.

Setting Dividers on Micrometers

MACHINISTS and toolmakers will find useful the illustrated attachment for setting dividers on micrometers. It consists of two steel rings with marks about the circumference somewhat similar to the marks on the barrel of the micrometer. The rings are made so that they can be pushed on the screw and fitted tightly enough to hold well. The circumference marks on the rings are .050 in. apart when the rings are in place; this allows the end of the anvil and screw to go .005 in. outside the rings, so that the micrometer can be used as usual.



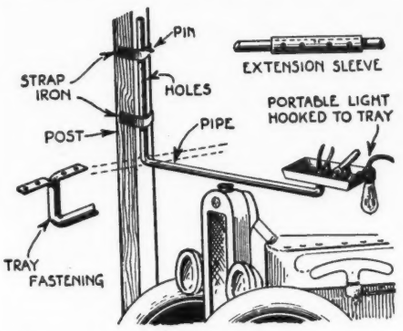
The rings do not prevent the use of the micrometer for ordinary work

To use the dividers for laying off radii, divide the wanted diameter by 2, subtract .050 from the quotient, and set the remaining distance on the micrometer. Then place the dividers on the circumference marks on the ring. In setting dividers for length, subtract .050 from the distance wanted and follow the same method. These rings can be used on micrometers of any size or style.—S. C. H.

THE HOME WORKSHOP

Garage Work Speeded Up with Swinging Tool Trays

IN REPAIR work on automobiles often much time is lost because parts and tools are placed on the mudguards or the car frame and are sometimes knocked into the drip pan or to the floor. To avoid



Tray can be moved up and down as well as laterally

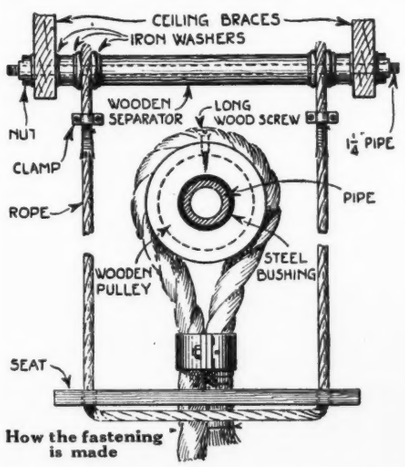
this difficulty, it is well worth while to make a simple swinging tool tray.

It consists of a rectangular pan supported by a pipe bracket, which is held against the side of the garage by means of two screwed clips. Several drilled holes and an inserted pin allow the tray to be raised or lowered. A further adjustment for extending the length is possible by making the arm of two pipes that telescope together and that may be retained in several different positions with a pin.— A. L.

Pulley-Like Fastening for Swing Rope Gives Long Service

IN ORDER to reduce excessive swing-rope expense, the management of a playground maintained by a large steel company for the children of its employees, devised the ingenious fastening pictured in the accompanying drawing.

The pulleys are turned from selected white pine and bushed with steel tubing.



How the fastening is made

The rope is fastened around the pulley with standard rope or cable clamps. To prevent the rope from sliding on the pulleys a long screw is forced between the strands of the rope and screwed into the pulley. The rope is thus given a longer life than if fastened by the older and more familiar methods. It was also found that the swing motion is much smoother with this new type of suspension.—JOHN H. SCHALEK.

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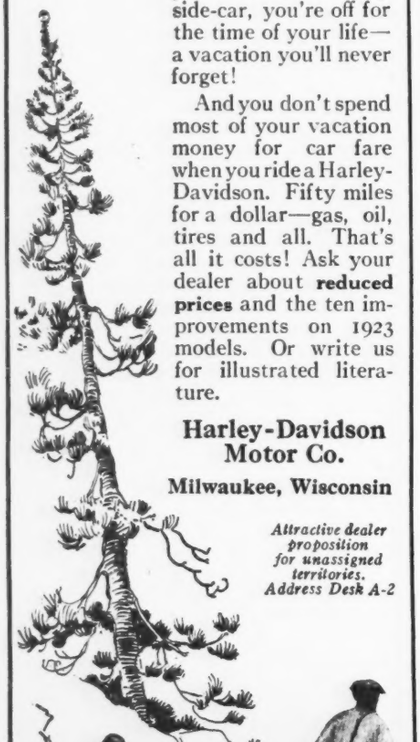

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In Justice to the Crystal Detector

(*Continued from page* 32)

low priced crystal detector outfit, has greater tuning range and suffers less annoyance from static than with a tube. The latter is true because the modern tube can stand a heavier load than the crystal, and hence will pass along in greater intensity the static tick. Of course, with the tube, the same effect is obtainable by the use of low filament current.

Another fallacy commonly preached at the beginner is that he cannot hope for much success with a crystal set in the heart of a crowded city, where there is much interference. The fact is, on the other hand, that the crystal is often the city man's greatest hope. Indeed, I believe that the increased use of crystal detectors will make reception in cities better all along the line. The heterodyning effect, by which a tube set may become automatically a transmitter, annoying many amateurs in the neighborhood, is now well known. One tube set in an apartment building, operated by a careless or inexpert beginner, at present often spoils reception for many other residents of the building and seriously interferes with all reception within a radius of several thousand feet. The use of crystal detectors by all of them would eliminate this exasperating interference.

An Untold Romance of Invention

(*Continued from page* 31)

minerals and furnace products that would operate as detectors.

It was following this period of experiment that Mr. Pickard perfected and patented the receiving circuits and the various types of contact and mounting for crystal detectors upon which is based his chief claim to fame as inventor of the crystal detector, and around which we may shortly see exciting legal warfare in the courts.

Another chapter in the drama:

About 1904, the DeForest Company, for which Mr. Pickard had become consulting expert, was taking the lead in radio communication, since with its ship installations it was showing wireless ranges of something like 600 miles, while its chief competitor, the Marconi Company, was able to handle messages over ranges of only about 200 miles. The DeForest operators were achieving their greatest records by use of the then widely employed electrolytic detector. Another company owning the so-called "Fessenden patents" on this detector, secured an injunction to stop its use by DeForest, and the De Forest Company at once faced seeming annihilation.

To their rescue came Gen. H. H. C. Dunwoody, with his so-called carborundum detector, a piece of carborundum wrapped with wire and contained in a fuse-shaped tube. Finally, to their further rescue, Mr. Pickard was summoned. The New England radio genius came and promptly showed the DeForest people how to make General Dunwoody's crude carborundum detector really work satisfactorily. He disclosed the radical and ingenious contact principle that he, himself, had been quietly developing for several years.

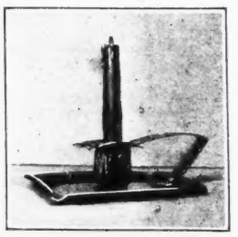
The DeForest Company breathed again. The crystal detector, had saved wireless from the grip of monopoly. After the hard times money from the sale of Mr. Pickard's new crystal detectors to the government and others began to come in. In 1907 he founded, with two others, the Boston company for which he is consulting engineer—one of the oldest radio companies in America.

THE HOME WORKSHOP

Ornamental Candlesticks Made of Hammered Copper or Painted Tin

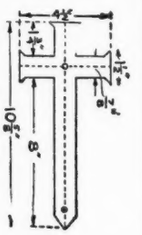
By Ann Roe-Anderson

THIS craftsman's candlestick may be fashioned from sheet copper or brass or even made from a discarded can that has contained sirup, coffee, or oil. "Hammer" the cup and handle and after riveting this to the tray—if tin has been used—paint the stick any desired color.



Candlestick when finished

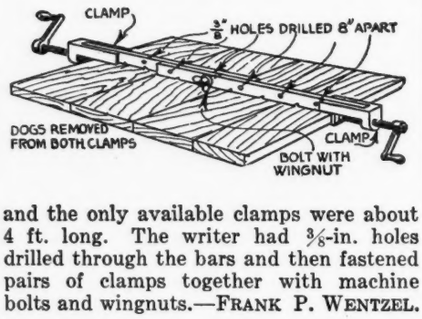
You will see from the diagram that the piece for the cup and handle is all one. It is 10⅝ in. long by 4½ in. wide. Draw a line 10⅝ in. long on the tin, using a ruler; measure 2¼ in. along this line and draw a line at right angles to it 4½ in. long; that is, 2¼ in. each side of the long line. Now you have the dotted lines as shown on the diagram. Work from these dotted lines to get the outside measurements.



The tray is 6 in. square, with the corners rounded off and the edge hammered or bent into shape.

Making Long Woodworking Clamps from Short Ones

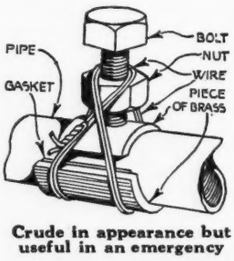
WHEN a long woodworking clamp is necessary, it often is possible to join together shorter clamps in pairs. This expedient first suggested itself when some tables about 6 ft. long had to be glued up



and the only available clamps were about 4 ft. long. The writer had ⅜-in. holes drilled through the bars and then fastened pairs of clamps together with machine bolts and wingnuts.—FRANK P. WENTZEL.

Quick Patch for Pipe Repairs

A SPLIT or leaking pipe may be repaired temporarily with an improvised clamp consisting of a bolt, a nut, and some wire. These, when used as shown, will hold a piece of brass and a gasket against the pipe with great pressure. It is a trick that has served me well on several occasions when I had to have a clamp in a hurry.—CHARLES H. WILLEY.



Crude in appearance but useful in an emergency

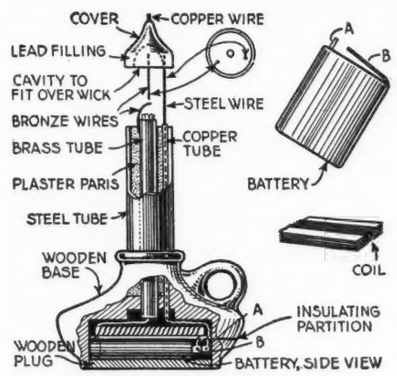
THE HOME WORKSHOP

Practical and Artistic Is This Cigar-Lighter

ANY one with a little mechanical skill can make this practical cigar-lighter.

First, make a square wooden base, with a cavity cut out from the bottom, or, to save this work, the lower part of the base may be made of four pieces of molding. The size of the entire lighter depends upon the size of the battery.

The upper part of the wooden base has a handle fixed to it and a 1-in. hole drilled in the center about 1¼ in. deep. The dummy candle is a piece of 1-in. bicycle tubing, through the middle of which runs a piece of brass tubing ⅜ in. in diameter. The brass tubing has a piece of bronze



A spark ignites the wick

wire soldered to it at the upper end, and is closed at the bottom. At one side a piece of ⅛-in. copper tubing is soldered to the bicycle tubing. Both the copper and brass tubes extend about ½ in. below the bottom of the steel tubing. The space in the dummy candle is filled with plaster of Paris. Two holes must be drilled into the base from the top to allow for the passage of the copper and brass tubes.

The coil is made with a core of several sheets of very thin soft iron. Tintype material is the best and should be slightly rusty. Around this core are wound about 100 ft. of No. 26 enameled magnet wire. Between the coil and the battery is a partition of some insulating material.

The candle-cover is made of a piece of 1-in. bicycle tubing about ½ in. long, filled with lead. In the lead is embedded a burnt copper wire for a wick, a hard steel wire, which serves as a connection by sliding up and down in the small copper tube, and a bronze wire, which serves as a contact. A cavity is hollowed out of the lead to accommodate the wick. This prevents a short circuit. A hole is made in the plaster of Paris for the bronze contact wire when the cover is down.

From the bottom of the brass tube a wire runs to the coil. From the opposite side of the coil a wire connects with one pole of the battery. From the other pole of the battery a wire connects with the small copper tube. Next, the plug is inserted in the bottom and secured with some very small brads.

A piece of round wick saturated with benzine or gasoline is inserted in the brass tube and the device is ready for use. To operate: lift up the cover about 1½ in. and twist it to one side. The bronze wires snap together and apart, striking a spark that lights the wick. Drop the cover back in place to extinguish the light.

The dummy candle should be enameled white and the wooden base stained.—E.G.G.

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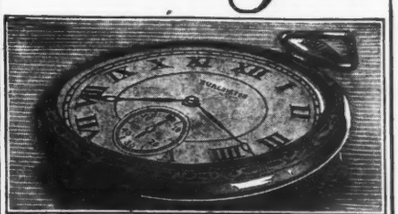

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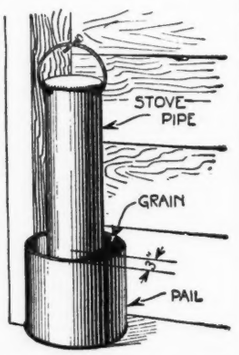
THE HOME WORKSHOP

Making a Poultry-Feeder with Stove-Pipe and Pail

A CONVENIENT poultry-feeder that will not clog or waste in feeding any kind of dry mash or grains, may be made from a length of stove-pipe and a pail or tin with straight sides.

For a 6-in. pipe, a container about 9 in. in diameter and 7 or 8 in. deep is right. With two rivets one end of the pipe is attached to the side of the container, extending into it 4 in.

The feeding aperture between the outside of the pipe and the rim of the container must be 3 in. at the widest point and the end of the pipe must be 4 in. below the rim. The space below, in which the grain feeds out into the bottom of the container, may be from 2 to 4 in.

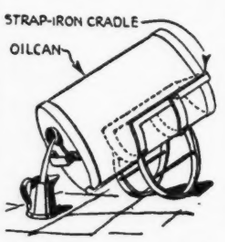


This feeder prevents waste

A lard-pail or sugar-pail cover fits over the top, and a bail or piece of wire is hooked into that end as shown, by which the feeder is hung and handily carried with several others in one hand.—R. B. C.

Cradle for Oilcan Lightens Work

ANY one who has a 5- or 10-gallon can of oil to handle, whether he is a motorist or a garage man, will appreciate a cradle such as is illustrated. It makes it easy to pour oil out of a large can into a smaller container.

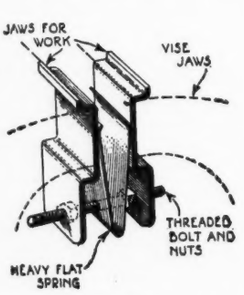


For 5- or 10-gallon cans

The cradle may be so designed that it is equally useful whether the can is almost full or nearly empty. In the design illustrated, the cradle is made entirely out of welded strap iron.—H. B.

Easily Made Filing Jig Saves Vise Jaws from Damage

WHY file into the jaws of a good vise when in a few minutes' time you can make a jig that will save both vise and file? It can be made to fit any size vise and will hold all kinds of thin work. Once firmly gripped in the jig, the work cannot slip down and is not likely to shift sideways.



For filing thin work

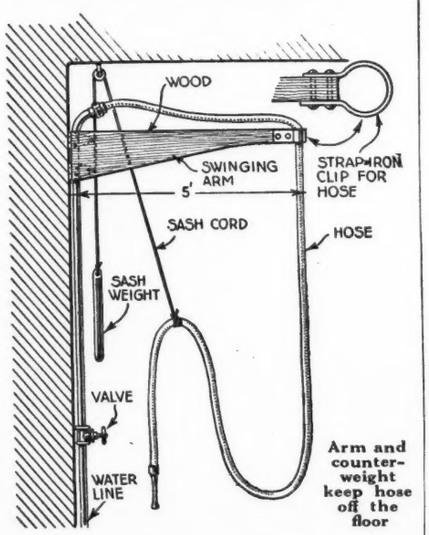
The illustration clearly shows the construction of the fixture, which consists of two jaws shaped to fit the vise jaws, a threaded rod, two nuts, and a spring.—W. L. GILLESPIE.

THE HOME WORKSHOP

Overhead Washer for the Garage Prevents Wearing Out Hose

TO SAVE wear and tear on rubber hose and to facilitate the washing of automobiles, an overhead arm may be rigged up quickly in the garage as shown in the accompanying drawing. If the hose is not provided for in some such way, the wheels of the car are apt to run over it, and often it will be dragged over the more or less rough cement floor.

The hydrant pipe should be continued to a position well above the top of the car.

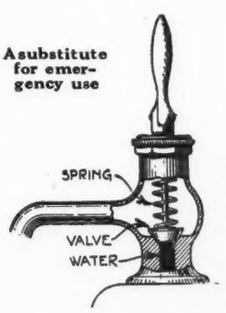


Mount a swinging wooden arm by means of two hinges and attach the hose as shown. Then arrange a pulley, cord, and counterweight, or sash weight, in such a way as to raise the hose out of the way when not in use. The counterweight should be slightly heavier than the hose extension, but not heavy enough to prevent the hose's being handled readily while washing the car.—L. A. G.

Faucet Serves as Safety Valve

THERE are many places in the home and shop where a safety valve should be used, but they are sometimes omitted on account of the expense.

A good substitute may be made by using a water faucet of the type shown in the illustration, which can be bought at any hardware store, and which has a valve that ordinarily is held closed by a spring. The spring is released by squeezing the handles together. Therefore when the faucet is used as a safety valve, the pressure will force the valve open against the spring whenever the pressure becomes strong enough.



In a bakery with which I am familiar, the burner that heats the oven burns oil. A faucet like this has been used for a safety valve for several months. Several times when the electric air compresser was not turned off, the valve "popped" at a pressure of about 40 lbs.—J. N.

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THE HOME WORKSHOP

Building a Phonograph Record Cabinet

By Clifford A. Butterworth

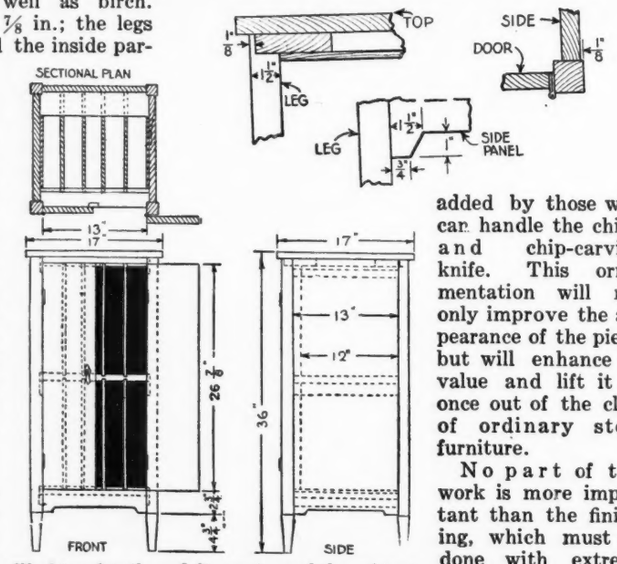
FOR those who have a phonograph that is not of the cabinet style, the record cabinet illustrated will prove a useful addition to the living-room furniture. It will not only provide a place for the records, where they will be protected from dust and damage, but it will also serve as a stand for the phonograph. Space is provided for ten record albums of standard size.

Oak, or birch, finished in mahogany, is suitable for the cabinet. Whitewood also may be used, although it will not take the mahogany stain so well as birch. Most of the stock is ⅞ in.; the legs are 1½ in. square and the inside partitions are ¼ in. in thickness.

After the boards for the sides, back, and top have been glued and cut to size, the legs, which are tapered off at the bottom to 1 in. square, are doweled to the side and back panels. To these panels are screwed the upper and middle cleats, which are ½ in. thick and 1½ in. wide, and the bottom cleat, which is 1 in. wide.

To the under side of the 17-in. square top are fastened two pieces of ⅞-in. stock about 3 in. wide, at the front and back. Across these pieces are fastened 5 filler blocks of ¼-in. stock, with ¼-in. spaces between them to serve as the upper grooves for the vertical partitions. The partitions themselves are spaced 2⅝ in. from center to center. The top section may be doweled or fastened in any convenient way to the legs and side and back panels.

The middle shelf and the bottom are solid pieces that should be kept back 1 in. from the front edge of the legs. They are attached to the cleats on the side panels. In the middle piece are cut grooves ⅛ in. deep to take the vertical partitions. To the bottom piece are fastened blocks of ¼-in. stock to form grooves, as for the top.



Working details and dimensions of the cabinet

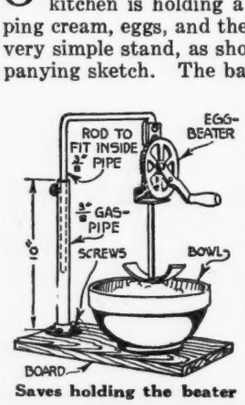
The cabinet is fitted with two doors 6½ in. wide and 26⅞ in. long. When fitting the hinges, be careful to have the pin extend at the corner of the leg, as shown in the door detail, so that the door will swing back all the way when open. Knobs and catches should be fitted to the door.

If desired, the doors may be decorated with banded inlays or rosettes, which can be purchased ready made from dealers in inlays and marquetries, or rosettes and borders of carving or chip carving may be added by those who can handle the chisel and chip-carving knife. This ornamentation will not only improve the appearance of the piece, but will enhance its value and lift it at once out of the class of ordinary store furniture.

No part of the work is more important than the finishing, which must be done with extreme care to get the best results. The first essential is to sandpaper the surface as smoothly as possible. If oak is used, it must be stained the desired shade, filled with a paste filler, shellacked, and varnished. If birch or whitewood is used, the filler may be omitted, as the shellac, if properly applied, and rubbed down after each coat with very fine sandpaper, will serve to fill the grain sufficiently. It is essential, however, that the surface be perfectly smooth, through application of either filler or shellac, before the varnish is applied. Use only a good quality of furniture varnish, put it on with a soft brush, and allow it to dry in a warm room that is free from dust.

Stand for Egg-Beater Is a Useful Kitchen Accessory

ONE of the most tiresome jobs in the kitchen is holding a beater for whipping cream, eggs, and the like, so I made a very simple stand, as shown in the accompanying sketch. The base of the stand is a ⅜-in. flanged union and the support a 10-in. length of ⅜-in. gaspipe. The pipe is tapped at the top for a thumbscrew, which locks in position the solid U-shaped rod. The beater is riveted or bolted to the flattened end of the rod.

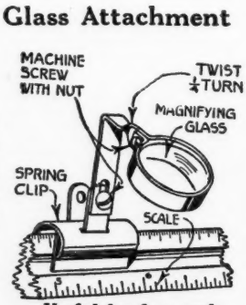


Saves holding the beater

For cleaning, the beater and rod may be pulled right out. The device should be screwed solidly on a ⅞-in. board.—H. C.

Magnifying Glass Attachment

IN LAYING out drawings to small scale, a magnifying glass assists a draftsman to make his measurements more easily and accurately. To hold the glass, a bracket made from 1/32 by ½ in. brass should be bent as shown and fastened with a machine screw and nut to a spring clip, clamped to the scale. A slide should be provided to adjust the lens to focus.—M. T.



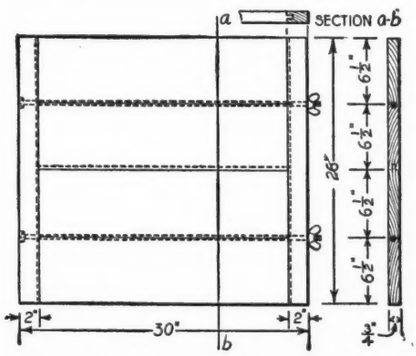
Useful for fine work

THE HOME WORKSHOP

A Draftsman Can Easily Carry This Large Drawing-Board

EVERY draftsman who has had occasion to carry a large and cumbersome drawing-board from place to place has felt the need of a portable board. The accompanying drawing shows the construction of one that is strong and rigid when set up, yet it can quickly be taken down to make a small and convenient bundle.

The board consists of four pieces of white pine or basswood held at the ends between strips of hard wood, such as oak or walnut. The whole is held firmly together by two long, thin bolts running through the length of the board. The two middle pieces of pine are joined by a tongue-and-groove joint,



The four pieces of this folding board are held together by end battens and long bolts

which is easily made with a combination or match plane. The outside edges of these boards and the inside edges of the outside boards each have a semicircular groove to fit the bolts. The ends of the pine boards are also tongued to fit into grooves in the hard-wood strips.

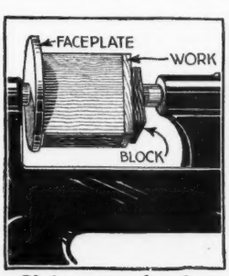
The bolt holes in one of the hard-wood pieces are counterbored for the bolt heads, so that there will be a smooth edge for the T-square.

The bolts may be made from ¼-in. rod, with heads forged at one end and threaded for wingnuts at the other.

This board, if carefully made, has two smooth drawing surfaces, and while it may be taken apart or assembled with ease, it will be found quite strong. The dimensions may be varied to suit conditions. As shown, the pieces fit together compactly; a neat case of sheet metal may be made for them.—LESLIE G. ROLLER.

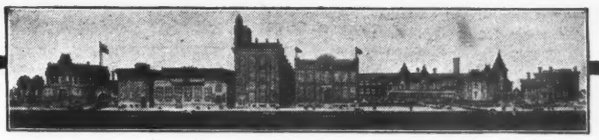
Lathe Used as a Clamp

OFTENTIMES the amateur mechanic or carpenter is in need of a clamp to hold a freshly glued box or other wooden article and resorts to makeshifts when he could easily bring his lathe into use for this purpose.



Gluing up a box between head- and tailstocks

The faceplate is put on the head of the lathe and the tailstock moved forward. The glued article is placed between the faceplate and a heavy block of wood. The tailstock spindle is then screwed forward until the box is held rigidly.—W. R.



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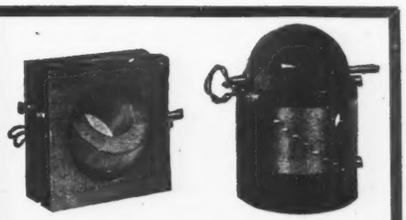

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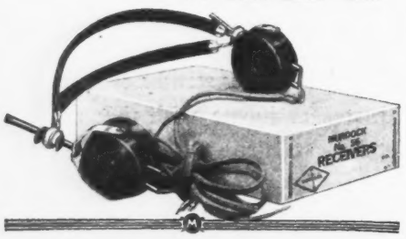

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How to Make a Low Voltage Voltmeter

PROCURE a brass or copper pipe about ½ in. in diameter and 4 in. long. Cut two wooden ends for the tube, each 2 in. square, with a round hole in the middle of each, which will fit snugly over the brass tube, one at each end.

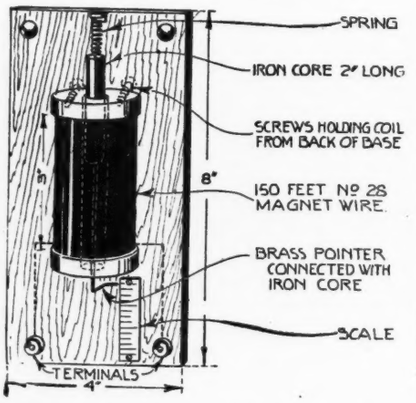
Next, wrap the tube with waxed paper and wind with 150 ft. of No. 28 single cotton-covered wire.

Make a base of wood 8 in. long and 4 in. wide, and mount the coil in the center of it.

Suspend a 2 by ⅜ in. iron rod by a small brass spring so that it extends downward into the coil about an inch.

Attach a stiff copper wire to the bottom of the iron rod, long enough to project ½ in. below the bottom of the coil. Bend about one fourth of the wire to one side to serve as a pointer. Glue a small strip of paper under the point of the wire for the scale.

Get five dry cells and connect one of them with the coil. Make a mark where the point of the wire comes to a stop; this is the 1½-volt mark. Do the same with two cells, then three, and so on until all of the five cells have been used.

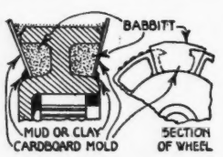


Try out your battery with a home-made voltmeter like this that will measure low-voltage currents

If the iron plunger is pulled down too easily, use a stronger spring. Mount two binding-posts on the base and connect the two coil wires with them on the under side of the base.—J. W. DENNIS.

Repairing Broken Lawn-Mower Tread

THE tread of a lawn-mower wheel is sometimes broken when the mower is rammed against the edge of the curb or a stone. Such an accident recently broke the rim of my mower, but a repair was made with little difficulty by casting babbitt metal in place of the section broken out.



A babbitt casting is made

Cardboard was cut and fitted so as to inclose the section between two spokes where the break occurred and was held in place with wet clay. The metal was then poured into the cavity between the spokes, filling up the entire section. After the metal was cold, the outer surface was filed off to the proper radius.

While the babbitt does not sweat itself fast to the wheel, it is prevented, by the means described, from falling out by the corners, spokes, and unbroken portions of the rim.—JOE V. ROMIG.

Mounting Adjustable Motor

THE home workshop mechanic who has a small electric motor can mount it on a board and hinges in the manner shown so that considerable belt adjustment can be made to suit the work the motor may be called upon to do.

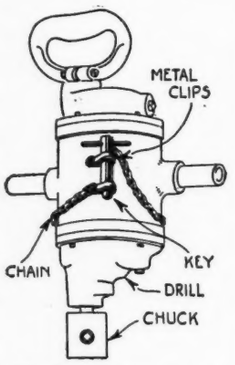
The belt tension can quickly be changed

The motor is bolted to a piece of hard wood. Hinges are placed on the upper edge and two elongated slots are cut under the motor to take the adjusting screws with which the belt is tightened. Two stiff springs are used on these screws behind the board, as shown.—C. W.

Chain Prevents Loss of Key for Portable Drill Chucks

THE key for the drill chuck on an electric portable drill can rarely be found in the average shop. The accompanying drawing shows a stunt devised by the writer for keeping the key where it is wanted.

Fasten two spring steel clips with cap screws to the body of the drill. These clips are used to hold the key in place when it is not in use. A chain is fastened under the screw at one end and around the key at the other. It should be made just long enough to go around the drill and then it will not be in the way. In most cases this length will be found just about right to reach the chuck.—W. B. B.



The key is always handy

Neat Window for Radio Panel

THE appearance of some radio panels can be improved by using a Ford ameter lens and rim to form a window for the opening through which the light of the vacuum tubes is watched. These can be purchased for a few cents at automobile accessories stores and many garages. If ventilating holes are desired, they can be bored above the tubes or at the side or back of the cabinet.—C. E. RODEHAVER.

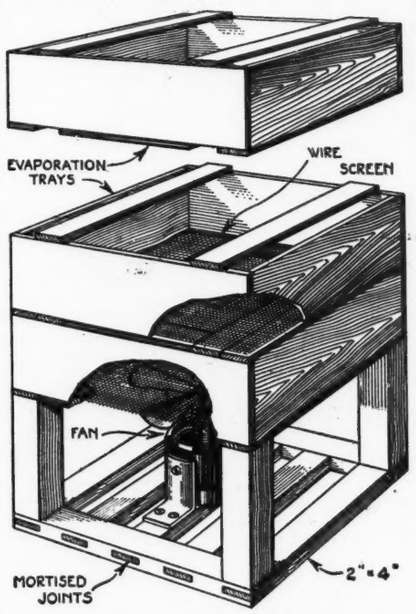
THE HOME WORKSHOP

Evaporating Vegetables and Fruits with an Electric Drier

By J. Arthur Frank

FIFTY years ago drying fruits and vegetables was accomplished by the slow and unsanitary process of spreading them on the attic floor and letting time and nature dehydrate them. Now they may be dried with the aid of an electric fan.

The foodstuffs to be dried are placed in wooden trays, the bottoms of which are of fine window screening. Beneath the stack



An electric fan forces the air through the drying trays

of trays is an electric fan, the blast of air from which evaporates the water content of the fruits and vegetables.

For the frame use two by fours and, if possible, mortise the joints. The first tray is built permanently on the four corner posts; the others are constructed so as to fit one above the other. For the average electric fan, the trays should be about 18 in. square and 6 in. high, of ½-in. stock. By means of the two slats on the top of each tray and corresponding slots on the bottom, the several trays may be nested one above the other. The motor is fastened to the framework with two heavy iron angles.

Before the fruits or vegetables are spread out to dry, they should be thoroughly washed, dried, pared and sliced and clean cheesecloth should be laid on the screens. Practically all vegetables and many fruits lend themselves to this method of preserving, including carrots, parsnips, and other roots. These root vegetables should be very thinly sliced. When thoroughly dry, the products may be packed away in cardboard boxes.

Preserving Nickel Finish

NICKEL-PLATED surfaces may be kept brilliant by wiping them with a cotton rag moistened with a solution of one part sulphuric acid and 50 parts alcohol. Quickly rinse the metal with clean water and dry with a linen rag. This method prevents wearing away the finish through use of gritty polishing powders.—D. H.

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THE HOME WORKSHOP

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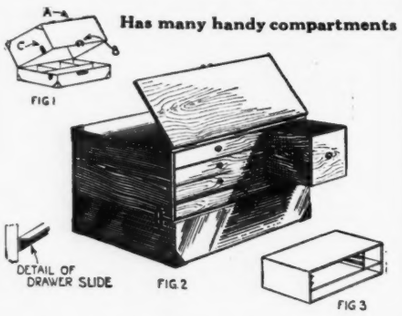
ALTHOUGH there is no part of a fisherman's equipment more necessary than a tackle box, it is difficult to get one that is just the right size and design. Any man handy with tools can, however, make his own tackle box.

The one illustrated is made of ⅜-in. oak, the lower section, if not the entire case, being covered with tin. Closed, the box stands 8 in. high; it is 8¾ in. wide and 13 in. long. The top section is 5⅛ in. high, the



Has many handy compartments

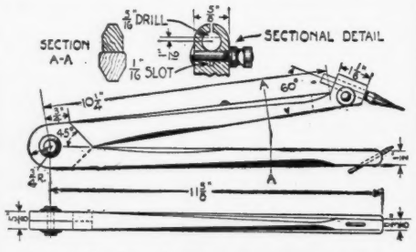
lower section 2⅞ in. Each of the 4 drawers in the upper section is 1⅛ in. deep. The square drawer for the reel is 3¾ in. on each side. The hinges for the drop fronts are indicated at *A* in Fig. 1; *B* is the lock and *C* shows one of the two catches which hold the sections together.

The lower section is partitioned off as shown in Fig. 1 and the upper section as in Fig. 3. Drawers for the latter may be made of tin and should be partitioned to accommodate the assortment of artificial minnows and lures. All tin parts should be given at least two coats of black asphaltum paint, and the wood must be spar varnished or thoroughly oiled and waxed to make it as waterproof as possible.—R. P. L.

How to Make Wooden Compasses for Large Drawings

By Walter Lyon

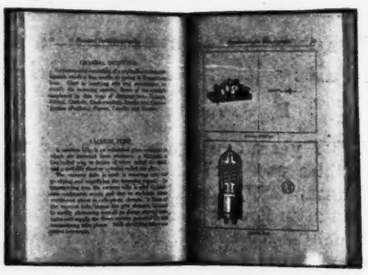
IN MAKING large layouts I find use almost every day for the wooden compasses illustrated, and they are very often borrowed by men in the pattern room. Shaping them is a neat problem in woodwork, but if sufficient care is used, the



A serviceable drafting instrument for full size layouts

finished instrument will be found both accurate and durable, and in some respects handier than a beam compass.

Clear, dry, hard maple is preferable for the legs, and for the metal parts odds and ends may be picked up around almost all home workshops. The washers for the joint should be dished to provide sufficient tension for holding the legs firmly in any given position.



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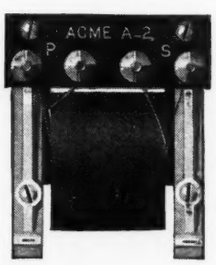
THERE'S more than one "howler" to put to sleep these days. Your radio set can put on the greatest squalling and howling demonstration you ever dreamed of. The surest way to stop this howling and keep it peaceful is to add an Acme *Audio* Frequency Amplifying Transformer.

Most any amplifying transformer can magnify the incoming sounds but it also amplifies the howling and distortion of stray fields in the circuit. Acme Transformers with their specially constructed iron cores and coils eliminate this disagreeable feature—and it only takes five dollars to buy one.

Acme assures your receiving a large volume of sound that possesses the natural tones so lacking in the ordinary receiving set. Then, too, you will want the Acme *Radio* Frequency Transformer which costs the same as the Acme *Audio* Frequency Transformer. It can be used on both crystal detector and vacuum tube sets. It greatly increases the range of either.

You can buy either transformer at your nearest radio store or write the Acme Apparatus Company (pioneer transformer and radio engineers and manufacturers), Cambridge, Massachusetts, U. S. A. (New York Sales Office, 1270 Broadway.) Ask also for interesting and instructive booklet on the use and operation of Amplifying transformers.



Type A-2 Acme Amplifying Transformer
Price $5 (East of Rocky Mts.)

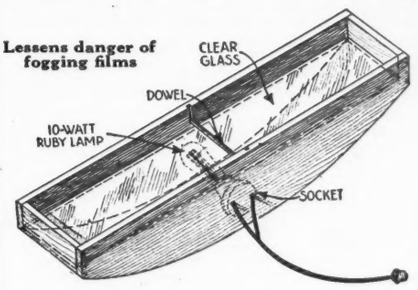
ACME
for amplification

THE HOME WORKSHOP

Developing Tray Has Ruby Lamp for Illuminating Films

THIS combination developing tray and ruby lamp lessens the danger of fogging a film by taking it out of the solution in order to see whether it is fully developed.

The tray is of ½-in. wood, 4 or 5 in. wide and 30 in. long. The side pieces are cut as shown, so as to allow an electric lamp



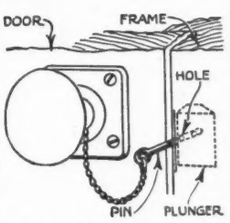
and socket to be placed beneath the sheet of window glass that forms the bottom of the tray. The glass is fitted into grooves and is sealed with paraffin, with which all wooden surfaces exposed to developing fluid also are coated.

There are two short vertical grooves at the center of the side pieces, as shown, to take the ends of a dowel. One end of the film to be developed is slipped under the dowel, and each end is then held with developing clips.

Rocking the tray causes the solution to flow from end to end and assists the developing process. In order to see the condition of the film, all that is necessary is to switch on the ruby lamp from time to time.—EDWARD W. PRASEK.

Door Locks without Key

A SIMPLE way to lock a door from the inside without a key is illustrated. Drill a small hole through the latch bolt of the door lock as close to the door frame as possible. When the door is closed, insert a nail or steel pin into the hole. It will then be impossible for any one on the other side to turn the knob. I have found this device especially useful in connection with dumbwaiter locks.—JULIUS H. LUTZ.

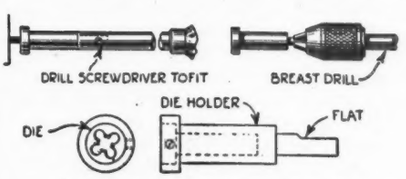


A quickly made lock

Breast Drill Speeds Threading

FOR rapidly rethreading a number of studs and screws, I use a die-holder held in a breast drill. The holder is made in a lathe from a piece of cold rolled steel.

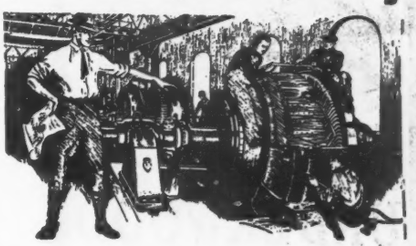
I also have converted an old screwdriver to take this holder for use in rethreading



Handy die-holder for small work

rusted, burred, and tight studs. It makes possible the use of small round dies to good advantage for this kind of work.—C. W.

Electrical Experts EARN $12 to $30 a Day



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Trained "Electrical Experts" are in great demand at the highest salaries, and the opportunities for advancement and a big success in this line are the greatest ever known.

"Electrical Experts" can earn $70 to $200 a week. Fit yourself for one of these big paying positions—

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Today even the ordinary electrician—the "screw driver" kind—is making money—big money. But it's the trained man—the man who knows the whys and wherefores of Electricity—the "Electrical Expert"—who is picked out to "boss" ordinary electricians—to boss the big jobs—the jobs that pay.

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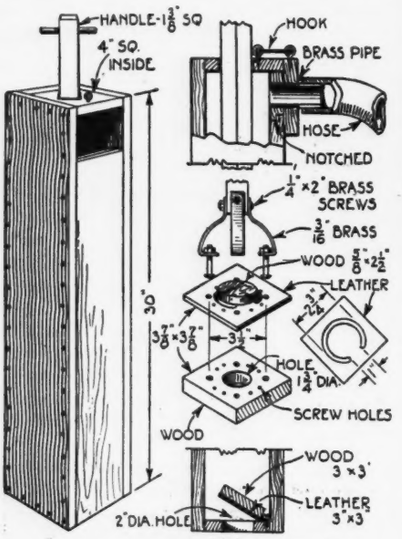
THE HOME WORKSHOP

Wooden Pumps that Float Are Favored by Some Boatmen

By Henry S. Laraby

BOAT pumps that are entirely practical and are used by many oyster tongers I have known are constructed of wood. Their advantages are that they will not sink, they do not tend to roll, they have a large outlet, and they will stand harder treatment than the ordinary iron pumps.

The dimensions given in the illustration are for a pump used on a 25-ft. cruiser. Pumps on the same plan are made as small



Showing the pump and details of its valves and outlet

as 1½ in. square inside and 12 in. long, for canoes. In any event, the pump should be long enough to bring the outlet over the coaming when the pump rests on the bottom of the boat.

The pump casing is a wooden box in which works a plunger composed of a wooden block and a ¼-in. thick leather flap fastened with brass straps to a square plunger rod. Ample allowance should be made for the swelling of the plunger block, in this case ⅛ in. The leather on the plunger is made ½ in. larger all around than the inside of the pump box and is forced in. The bottom of the box is closed with a block in which a hole is bored and fitted with a simple leather inlet valve. The removable hose attachment is made from two blocks into which a brass pipe has been screwed and is fastened to the pump proper with a hook and eye. These details are all made clear in the accompanying drawing.

A Glass Chess and Checkers Board

A FINE looking chess and checkers board may be made of plate glass.

Cut a piece 15 in. square and grind the edges smooth with emery powder and turpentine. Mark off lines 1½ in. from each edge, thus leaving a square 12 by 12 in. Divide this square into 64 small squares, each 1½ by 1½ in., by marking off eight divisions on each side 1½ in. long, and joining across to the opposite side. Paint alternate squares black and fill up those remaining with red or yellow. Then paint the 1½-in. borders with a suitable color.

The completed board should be inserted into a frame or table, painted side downward.—EUGENE ELSTON.

DON'T SWEAT OVER A KITCHEN STOVE!

No excuse any more for fussing and fuming over a hot kitchen stove in summer time! No need of keeping a hot fire going all day just to do a little cooking. Amazing new invention does away with this dirt, muss, and kitchen drudgery.

Amazing Invention

Gives plenty heat when you want heat. You turn it off instantly when you don't want heat. Cheaper—Burns 95% air—5% oil. Saves money, time, labor, health. No fires to make, no ashes, dirt, smoke, odor, chopping, shoveling, carrying dirty coal or wood.

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Don't let your coal-and-wood stove turn your kitchen into a roasting-room. Wonderful invention—Oliver Oil-Gas Burner gives quick heat at turn of valve. Fits in fire box without adjustment. Note how simply it works. Absolutely safe. Lasts lifetime. Fine all seasons. No roasting Summer kitchen. Ready heat in chilly Fall and Spring. 2 times more heat in Winter. FREE BOOK telling all about the "New Kind of Heat," sent free. Also amazingly low introductory price offer including 30-Day Trial. Write today. OLIVER OIL GAS BURNER & MACHINE CO., 2007-1 Pine St., St. Louis, Mo. Oldest, Largest Manufacturers of Oil-Gas Burners in the world.

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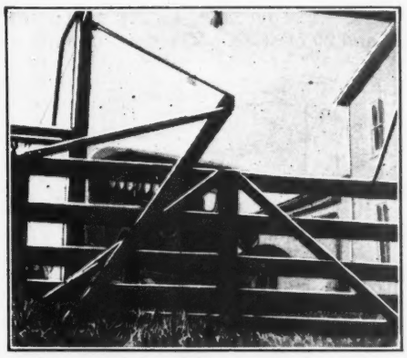
THE HOME WORKSHOP

Farm Gate Can Be Opened without Leaving Automobile

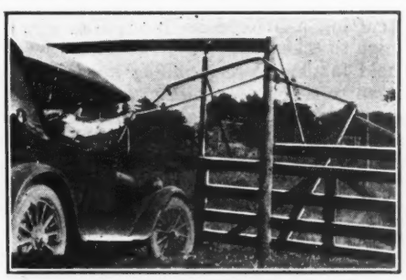
A FARMER can open a gate such as the one illustrated without leaving his automobile, buggy, wagon, hayrack, or tractor. The simple mechanism that opens the gate is operated by pulling a rope that



The operating mechanism seen from the inside of the gate

passes over pulleys on the top of a pole and is carried within reach of the driver by a projecting iron rod.

When the rope is pulled, it lifts up a beam pivoted at the bottom of the pole. A connecting rod between the upper end of this beam and one end of the gate pushes the gate open as the beam is raised. When the



Gate slides back when rope is pulled

beam is in a vertical position the gate is half open and momentum and gravity carry the beam down on the other side of the pole, consequently opening the gate fully.

For this device to operate successfully, the gate must be well mounted with wheels on an overhead track so as to slide easily.—FLORENCE L. CLARK.

Removing Tight Headlight Rims

WITH the aid of a length of rubber cut from an old inner tube, it is usually a simple matter to take off a stubborn

headlight rim. Stretching the rubber as tightly as possible around the rim, as shown, will be found to give a good grip that will not slip.—D. V. H.

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International Studios, Inc., Dept. 2386
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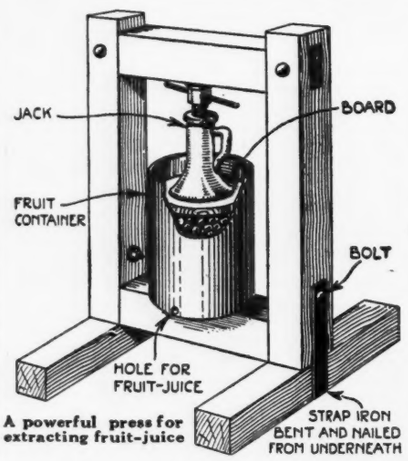
Screw Jack Provides Pressure for Homemade Fruit Press

WHEN the purchase of an expensive fruit press is not warranted, one that will serve all ordinary purposes can be made at little cost by using a small screw-jack to provide the pressure.

The framework is made of 4 by 4 in. timbers. A convenient size for it is 30 in. high and 20 in. wide. The base supports a



A powerful press for extracting fruit-juice

container, in this instance a 6-qt. can taken from a discarded ice-cream freezer.

The jack is fastened to the top member by cutting a hole in its lower side large enough to take the head of the jack, which is held in place by toenailing it securely. The bottom of the jack rests on a circular piece of 2-in. plank slightly smaller than the inside diameter of the can. This piece should be planed up and sandpapered as smoothly as possible. It is important that the construction should be rigid.

If a larger container is used, the lower crosspiece should be made sufficiently wide to form a solid base.—DALE R. VAN HORN.

A Neat Clothesline Reel

THIS clothesline reel, which is often mistaken in its leafy setting for a bird-house, is made of short lengths of shiplap on a frame of odds and ends of 2 by 4. The whole is then fastened firmly to the tree by means of a frame that encircles the trunk, and is braced with a bracket.

Resembles a bird-house

The roller is 18 in. long and 3 in. in diameter. The crank handle is from a cast-off clothes-wringer, and the iron pin that holds the crank in place after the line is drawn taut is a ⅝-in. bolt 8 in. long.

On the roller is evenly wound a 100- or 150-ft. length of good clothesline. Four, five, or six pulleys, as may be desired, are threaded on the line. An equal number of stout screwhooks are placed conveniently on buildings or other trees. To each of these is hooked a pulley, after which the line is wound tight and the crank locked. If the line slackens after the clothes are on it, another turn of the roller will tighten it once more.—R. A. FRANKLIN.

Radio

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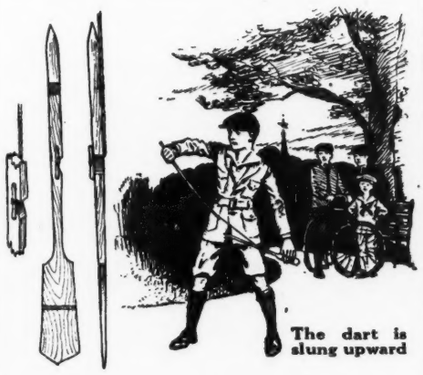
THE HOME WORKSHOP

This Sling Shoots an Arrow Whittled from a Shingle

A SLING and arrow that will give any boy vast amusement can be made with a jack-knife. Whittle a strip of wood about 16 in. long—a shingle will be just the thing—to the shape of an arrow and somewhat like a blue-jay's tail. The arrow should be approximately square in section toward the point and taper gradually to where the tail begins.

At about the middle cut an angular notch. An ordinary string a little shorter than the arrow with a small twig about 1 in.



The dart is slung upward

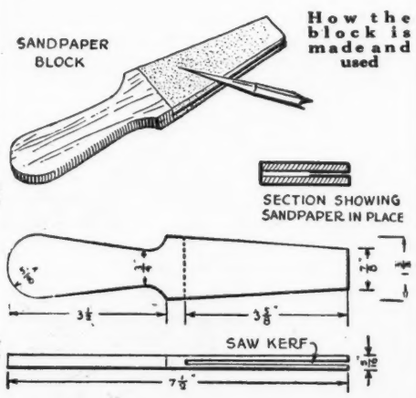
long tied to one end, is fastened to a stick or small branch.

To shoot the sling, catch the string in the notch, hold the arrow lightly by the tail and grasp the stick in the other hand. Give the arms and the toy a swinging motion back and forth in an upward direction several times. Then let fly. If properly made, the arrow will ascend as high as 200 ft. and come down point first, sticking into the ground.

It may require several attempts to cut a properly balanced arrow. If it whirls around in the air only a few feet up, the notch may need to be placed farther above or below the notch. When proficiency is attained, one arrow may be used until the point becomes blunt by constant impact with the ground.—A. E. ZIPPRICH.

Renewable Sandpaper Block

THIS sketch illustrates a simple method of making a sandpaper pencil pointer that is easily renewable. The handle is of



wood, shaped as shown. A piece of fine sandpaper or emery cloth is folded to fit the block and slipped on with the loose ends in the slot, which holds the abrasive securely in place.—ALEXANDER GRABAU.

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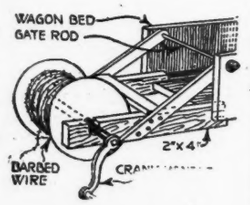
THE HOME WORKSHOP

Barbed Wire Reel Is Carried on Wagon End Gate

TO MOUNT a reel of barbed wire when running farm fences, a wooden frame with iron axle and crank handle may be attached directly to the end gate of a wagon. The frame is made of two pieces of 2 by 4, 3 ft. long, mortised to fit the floor of the wagon. These pieces are supported by two 1 by 6 in. braces and made rigid by another crosswise brace.

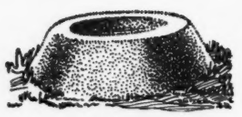


Saves time in stringing farm fences

In unrolling a spool of wire, the free end is tied to a post and the wagon is driven forward. In coiling up loose wire the crank has to be turned by hand.—G. H. DACY.

Making Concrete Bird Baths

ARTISTIC concrete bird baths may easily be made by using two discarded kitchen pans for molds. A dish about 20 in. across will serve for the outside form, and another dish 6 or 7 in. less in diameter, with either vertical or tapering sides, will make the inside form. These two are placed as shown in the illustration.


The mold and the finished bath

In mixing the concrete, use clean sand or gravel and add enough water to form a mixture that is quite soft. The concrete is carefully poured all around the inside dish and on top of it until the larger dish is filled. When the concrete is removed, after it has hardened, a thin coating of pure cement wash should be given to both the outer and inner surfaces to render them completely waterproof and enhance their appearance.—O. R.

Quickly Made Renewable Fuse

THE illustrated fuse plug is made from an ordinary separable knife-blade attachment plug. The fuse element is simply a strip of tinfoil. This is glued or fastened with shellac to a disk of mica in such a way that it forms a link in the circuit that will burn out if the current exceeds the carrying capacity of the tinfoil, the proper size of which can be found by trial.

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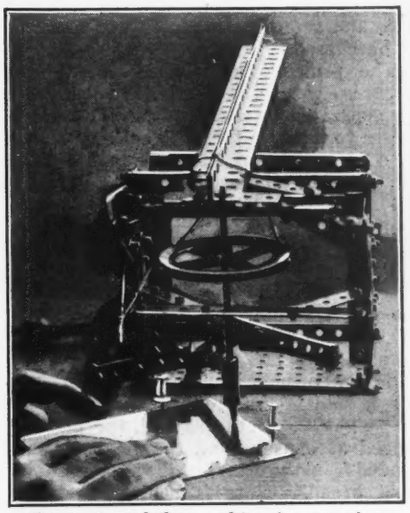
THE HOME WORKSHOP

How to Make a Small Motor-Driven Glass Drill

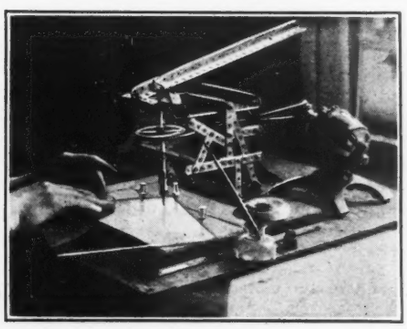
TO DRILL holes in glass, particularly near the edges, is one of the most exacting tasks the home worker has to do. It is not hard, however, to make a little machine that will exert uniform pressure and cut glass like metal. This device consists of a box-shaped structure, made either from metal or wood, in the form of an inverted L, in which runs a vertical shaft with a flanged wheel 3 in. or more in diameter. The shaft is provided with a coupling or chuck for holding the brass tube with which the drilling is done.



Front view of the machine in operation

The upper end of the shaft is pressed down by the weight of a hinged piece of wood or iron. For convenience, a lever is attached to the lower bearing of the spindle so that the drill tubing may be lifted off the glass at will.

The pulley of the machine is connected by a string belt with a small motor, in this instance a sewing machine motor. The glass to be drilled is placed under the spindle and held by means of a few thumbtacks. Moisten the glass with turpentine, place a little coarse carborundum under the tube and let the motor run slowly. If plenty of turpentine and carborundum are applied, the tube will drill through a piece of window glass in a few minutes.—E. B.



Made from toy parts and a small motor

IN STRETCHING the aerial, consider what would happen if the wire should fall. If other wires are below it, find out their nature. If an aerial wire should fall across a light wire, the aerial wire would probably burn off, but not before the apparatus had been ruined.—L. B. E.

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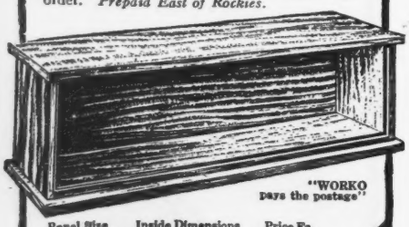

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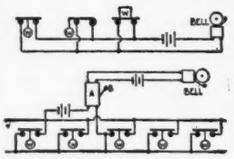
The principle upon which the alarm works is exceedingly simple. Two contacts are separated by a film of paraffin, which serves to insulate them. The heat caused by a fire will melt the paraffin and the contacts will come together and set off the alarm.



Various ways of arranging the contacts

Three arrangements are shown in the top diagram. In the first, a plate rests on two metallic pegs or nails and is held in close contact with them by the weight *W*. In the second, the plate is hinged at one end and the weight is suspended from the other; in the third, a somewhat broader plate is held against the contacts by a weight resting on it. Before placing the plates, they must be dipped in hot paraffin or hot paraffin poured on them at the places of contact.

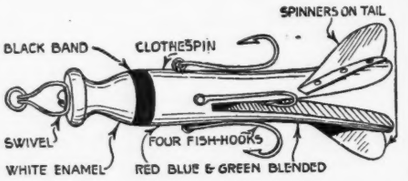
The system may be improved by using a constant ringing drop, as shown in the lower diagram.

Should a fire melt the paraffin at any one of the contact places, the relay *A* will become energized and arm *B* will drop. The bell will then ring continuously until the drop is restored to its normal position.—KENNETH A. SCHAAF.

How to Make a Wooden Minnow from a Clothespin

FROM a clothespin can be made a good wooden minnow. First make a swivel of stiff brass, bent as shown. Drill a fairly large hole through the bottom of it and two smaller holes through the lugs to take a wire ring. Attach the swivel to the head of the clothespin with a long screw. The head of the pin is left on because it causes a slight riffle in the water and helps attract the fish.

To each of the tines of the clothespin are attached spinner fins made of tin, fastened



A "killing" lure when properly painted

with small brads. It will be seen that each fin is set at an angle, pointing in opposite directions.

Fasten four hooks at equal distances apart around the middle of the clothespin. Paint the head white, and the body a blend of red, blue, and green. A narrow black stripe is placed where the minnow's eyes should be.

Give the finished article a final coat of first class waterproof varnish.—L. B. ROBBINS.

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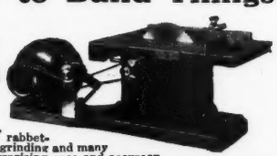

DOES your ripping, mitering, grooving, rabbeting, tenoning, sanding, grinding and many other operations with surprising ease and accuracy. Top 10" x 18". Saws 1⅝" stock. Driven by ½ hp. or 1/3 hp. motor. Portable. Runs from any light socket. All metal construction. Extremely accurate.

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Price complete with ½ hp. Ball Bearing motor as shown, $60.00.

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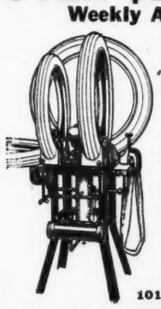

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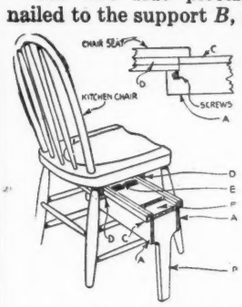
Desk A, Erie, Pa.

Shoe Shining Stand Attaches to Kitchen Chair

THE accompanying illustration shows how the writer added a shoe shining stand to an ordinary kitchen chair. When not in use the stand is pushed under the seat of the chair like a drawer.

The two side pieces, marked *A*, are nailed to the support *B*, and to a rectangular piece at the other end. Two slides, *C*, are fastened to the sides and bear against the pieces *D*, which are fastened to the bottom of the chair seat.

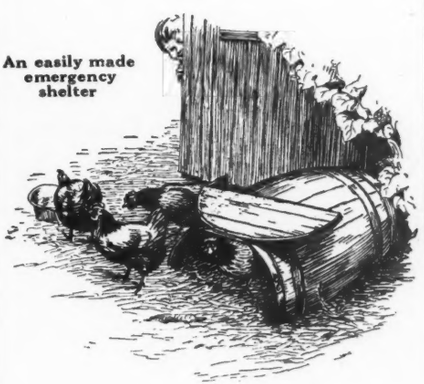


Stand pushes under chair

The top consists of two pieces, *E* and *F*, made in such a way as to provide a heel rest. The upper piece, *E*, is hinged so that it can be lifted up to get at the brushes, paste, cloths, etc. Two screws, one in the side of the drawer *A* and the other in part *D*, serve as stops that will keep the stand and drawer from pulling out too far—H. A. GUSTAFSON.

Barrel Forms Chicken Coop

IN AN emergency a chicken coop can be made by burying the lower half of an old barrel lengthwise. The inside is then



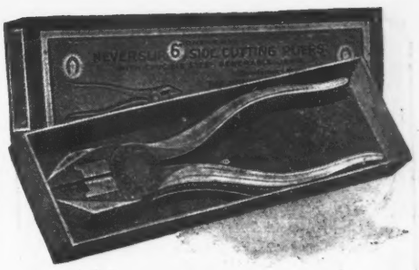
An easily made emergency shelter

filled with earth until the surface is a trifle above the level of the ground outside. Half the cover, hinged at the top, makes a door.—RAY CLIFTON.

Canvas Sling Protects Boat from Damage in Transportation

IF A boat or canoe is to be transported far when it is to be stored for the winter, it can be protected from unnecessary racking and damage by arranging canvas slings to hold it on the trailer or truck used for carrying it.

The damage that can be done a boat while being carted on an ordinary trailer will most readily be understood by those who have tried that method. Iron rods or other supports should be fastened to the sides of the trailer, and slings of doubled canvas, 6 in. wide, sewed along both edges, run between each pair of standards. If iron rods are used, their tops should be bent in hook shape to engage grommet rings sewn securely into the ends of the slings.—ROBERT PAGE LINCOLN.



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Here's a pair of pliers that you can't wear out. Neverslips are built to stand hard work. They'll outcut and outlast any pliers made because of their renewable cutting blades.

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And the cost of new cutting blades is nothing alongside the money you waste sending ordinary pliers to the scrap heap.

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Ask any hardware dealer to let you see a pair of Neverslip Pliers. Look them over carefully. Note the sharp cutting edges and the set of renewable blades. If you want to get *real* action and long life from a pair of pliers, buy Neverslips. If your dealer hasn't them in stock, send us his name and we'll see that you are supplied.

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If you use pliers or buy them for somebody else to use, you'll be interested in our booklet, "Procrastination is Not the Only Thief of Time." It's mailed free upon request. Do you want a copy?

"Red Devil" Rapid Boring Auger Bits are 33⅓% easier boring, have 10% greater clearance, and bore with or against the grain of any wood. Style 2400—10/16 in. shown here, 75c.

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Pliers

A "Red Devil" Plier is something more than a piece of metal given a certain shape. If it is worth using at all, it is because someone knew how best to select the steel for the particular purpose, how to forge it, how to temper it, how to finish it.

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Good Tools for Good Work

"Red Devil" Slip Joint Plier No. 924—an all-around tool for the home, office, car and garage. Size 6½ inches. From dealers or us, 50c.

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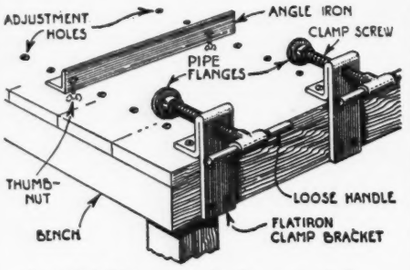
"Red Devil" Glass Cutters—the glaziers' standard tools of the world. "It's all in the wheel." Made in 40 styles. No. 024 shown below, 20c.

THE HOME WORKSHOP

Bench Vise for Carpenter Has Wide Range of Adjustment

By G. A. Luers

THE bench attachment illustrated has several advantages over clamps and the usual woodworker's vise for certain classes of work. This construction, as devised by a Washington mechanic, consists of a 2-ft. length of angle iron, with a hole drilled through each end. These holes correspond to holes drilled in two rows across the bench



A useful fixture for the home workshop

top. Two through bolts with wingnuts are the means of securing the angle to the bench.

At the edge of the bench two clamping fixtures are secured as shown. They are simply pieces of strap iron bolted on; the upper end of each is drilled and tapped for a clamp bolt. A flange on the end of each screw prevents the point damaging the wood.

This vise has a wide range of usefulness for sawing, planing, and holding parts while nailing, gluing, and the like.

Supporting Garden Flowers

MANY varieties of garden flowers are easily bent and broken by either high winds or heavy rains. Especially choice plants may be protected by making a support of four pieces of strong wire. Three of these are legs, each of which has a loop at its upper end. Through these loops the other wire is passed, and the two ends are bent around each other in such a way that the circle may be made larger or smaller to suit the plant.

Putting the ring in place

The legs of the support are driven firmly into the ground, and the plant grows up inside the loop, which will be concealed in time by the foliage.—E. B.

Making a Flexible Ruler

A FLEXIBLE ruler can be made cheaply by incasing strips of lead not more than ⅛ in. thick and ⅜ or ½ in. wide, in thin, tight-fitting rubber tubing. It will bend to an irregular curve and stay in place without any tendency to spring.

If it becomes uneven in time, place it edge up on a flat surface and tap it gently with a piece of wood.—E. A. McCann.

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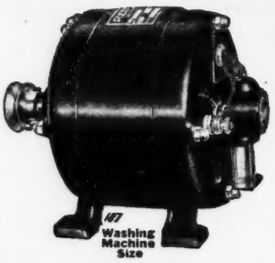
1/6 H.P. $10



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47 Washing Machine Size

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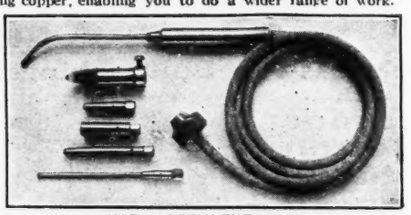

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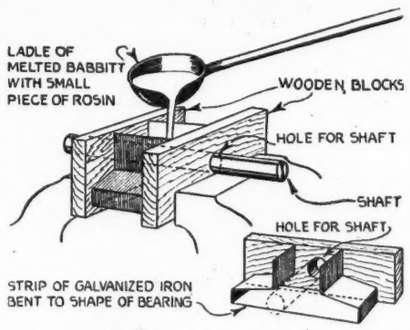
THE HOME WORKSHOP

Simple Method of Casting Small Bearings of Babbitt

USUALLY the amateur machinist experiences more or less trouble in casting small bearings for the machines he is using or making in his home workshop. After trying everything I had ever heard or read of with no great success, I finally hit upon a method of making a very simple mold that could be used again and again.

All that is required are two wooden blocks about ½ in. thick, of a size to suit


LADLE OF MELTED BABBITT WITH SMALL PIECE OF ROSIN
WOODEN BLOCKS
HOLE FOR SHAFT
SHAFT
HOLE FOR SHAFT
STRIP OF GALVANIZED IRON BENT TO SHAPE OF BEARING

The mold is held together in a vise

the over-all dimensions of the casting that is to be made, and a strip of galvanized iron or tin as wide as the bearing is to be long and long enough to be bent to the required shape, as shown above.

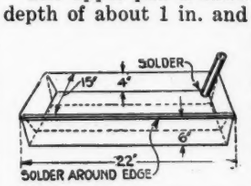
Drill holes in the blocks the same diameter as the shaft and place the shaft in them. Bend the strip of metal to the required shape and place it between the blocks, so that the shaft is properly centered in relation to it. Then clamp the blocks in the vise ready for pouring the babbitt.

It is well to place a small lump of rosin in the metal just before pouring to make it flow more freely.—P. CORK.

Fruit and Vegetable Drier

A RESOURCEFUL housekeeper had a tinsmith make her the drier illustrated. It consists of two galvanized iron pans, the outside 6 in. and the inside 4 in. deep, soldered together at the top edges. A funnel about 8 in. high is set into the bottom of the upper pan, so that the lower pan can be filled with water through it and steam can escape. Pans of any convenient size may be used; in this case the drier was 22 in. long and 15 in. wide.

The upper pan is filled with corn to the depth of about 1 in. and the lower pan is filled with water. An occasional stirring helps the drying process, but there is no danger of scorching the corn. About a bushel a day can be dried in this way.



The funnel must not be omitted

Pumpkin peeled and cut into 1-in. cubes can be dried by the same method. The drier has also been tried out for finishing apple and plum butter, and found to save the constant stirring that otherwise would be necessary. For cooking fruits, however, the galvanized metal is not particularly desirable, and the drier, or at least the inner pan, should be of aluminum. This would not be hard to arrange if an aluminum pan could be found that would fit tightly the galvanized outside pan.—WINIFRED YOUNG.

WHETHER an apprentice in the School of Experience, or a student in the finest Technical College in the country, no man graduates without an appreciation of good tools. Industrial developments have led to new theories and new practices but the dependable accuracy of Starrett Precision Tools is still an axiom in both machine shop and classroom.

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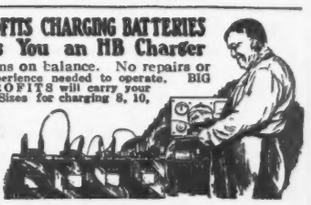

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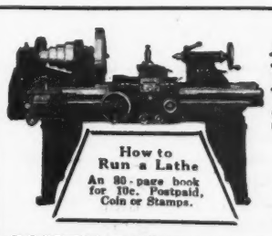

ANOTHER REDUCTION IN PRICES, JUNE 1, 1922
SOUTH BEND LATHES — EST. 1906

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Would he be worth the price of a Veeder Counter?—you can have him for that price. He's a Veeder Counter personified.

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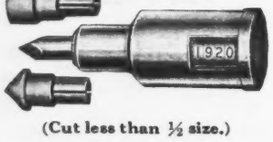
Veeder COUNTER

The Revolution Set-Back Counter below records the output of any machine where a shaft-revolution indicates an operation.

Sets back to zero from any figure by turning knob once round. Supplied with from four to ten figure-wheels, as required. Price with four figure-wheels, as illustrated, $10.00—subject to discount. *Cut less than one-half size.* Set-Back Rotary Ratchet Counter, to record reciprocating movements as on punch presses, $11.50 (list).

Speed Counter

Here's the handiest instrument for finding revolutions-per-minute of a shaft or flywheel. You hold the tip of the counter against end of revolving shaft; press lightly when the second hand of your watch comes to O; release pressure when minute is up. A spring clutch controls the recording mechanism.



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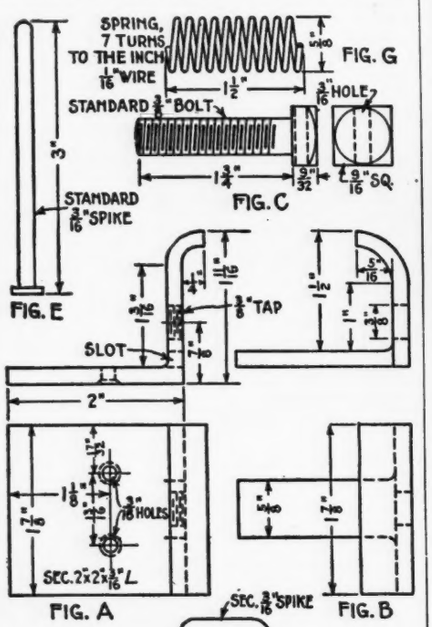
Vise Made from Bolt, Angle-Irons, Spikes and Spring

I MADE the vise illustrated from two pieces of 2 by 2 by 3/16 in. angle-irons, two spikes, one ⅜-in. bolt 1¾ in. long, one spring picked from the scrap pile, and one ⅜-in. plate washer.

One piece of angle-iron was bent as shown in Fig. A. Two holes were drilled in it and countersunk underneath, so that the guide made from the spike, shown in Fig. E, could be riveted flush with the bottom



The parts and how they are assembled

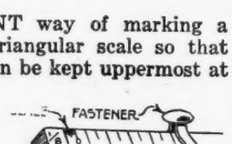
of the lower surface of the angle. Then I cut a slot ⅝ by 3/16 in., to take the tongue of the other angle-iron, Fig. B.

After I had slipped Fig. B through the slot, I drilled a 5/16-in. hole through both angles and tapped it for the ⅜-in. bolt, Fig. C. This was done so that the two holes would line up exactly. I then reamed out the hole in Fig. B to ⅜ in., so that the bolt would turn freely in it. The head of the bolt was drilled for the second spike, which served as a handle.

How the vise goes together is clearly shown in the assembly drawing. All it cost me was two hours' time.—F. N. WACHS.

Brass Paper Fastener Serves as Marker for Draftsman's Scale

A CONVENIENT way of marking a draftsman's triangular scale so that the proper scale can be kept uppermost at all times, is to use a brass paper fastener as a marker. It is attached to the scale by bending it in such a way as to grip the grooves. — FRANK HARAZIM.



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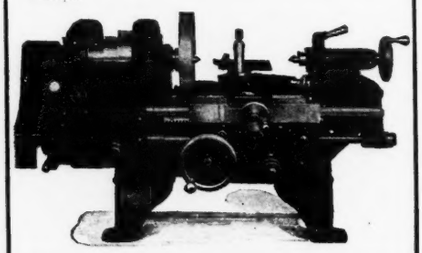

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"Reliability Built In"
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The Shipshape Home
How to Do the Odd Jobs

Replacing Glass

Now and then one of the panes of glass about the house will become cracked or shattered. If the replacement pane is to give lasting service, it must be set carefully and well.

First, the size of the glass must be measured by taking the up-and-down and the crosswise distances between the widest points of the old putty. It is best to have the new glass about 1/16 in. smaller so that no difficulty will be encountered when it is fitted into the sash.

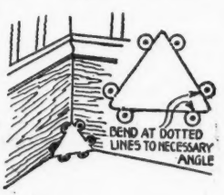
The old putty sometimes is very flinty and must be removed with a dull chisel and hammer. In doing this, break out the old glass first and the space it once occupied between the old putty and sash will be left open, thus facilitating the removal of the putty. If the old putty has been flaking off, as is often the case, the sash should be given a coat of linseed oil or paint in the glass rabbet or the new putty will also flake off.

When the rabbet has been perfectly cleaned and painted where necessary, the new glass can then be set in to see if it fits easily. If it fits well, it should be removed and a thin string of soft putty laid in the corners of the rabbet and the glass laid in that. Triangular zinc glazier's points should then be driven in to hold the glass in place. Never drive in a point at the center of the pane, as that is likely to crack it; distribute the points at regular intervals about 9 inches apart, more or less, working from opposite side to opposite side. The outer layer of putty should then be pressed in firmly and smoothly.

When smoothing off the putty, dip the putty knife in water and it will slide evenly and easily over the surface. This makes it easy to give the new putty a smooth and perfect finish.—LOUIS J. BECKER.

Keeping Corners Clean

MY WIFE was complaining about the difficulty of keeping dirt out of the corners of rooms and stairways. To overcome this I designed and cut out corner pieces as shown. Copper is the best for this purpose, although any sheet metal may be used. The pieces are nailed on with brass-headed tacks through holes in the round extensions. —C. J. STACKPOLE.



Making Screws Hold

WHEN screw holes become enlarged so that they do not hold the screws properly, I find they may be plugged with lead. Round lead in coil form is handy for this purpose. The screw seems to cut a thread in the lead that holds wonderfully well.

I have used this method of plugging screw holes in window frames for screens and storm sash and found it served much better than the usual custom of using wooden plugs.—GEORGE J. MATTOCKS, JR.

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FOR EVERY MAN WHO USES AN AUTOMOBILE

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It contains six blades, .0015", .002", .003", .004", .006", and .015" in thickness, which are used together or singly for measurements up to .0315". These blades are not rolled to size but accurately ground to the correct thicknesses. It has an eyelet in one end—you can carry it on a ring or hang it up.

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We will be glad to send you pamphlet describing this handy gauge, together with our Small Tool Catalog No. 28.

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The Midget "Five-in-One" Slide Rule
is a combination Mannheim, Polymetric, Log-Log, Binary, Add and Subtract Slide Rule. It will instantly add, subtract, multiply and divide any combination of whole numbers, fractions, mixed numbers and decimals. Gives every root and power, also Logs, Sines and Tangents. Made of aluminum with scales on white celluloid. Size 4 in. Approved and adopted by colleges. Price with instructions, $1.50. Leatherette Case 50c. extra. Catalogue Free.
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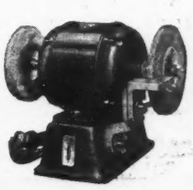

Grinder and Buffer, using above motor, 6 in. abrasive wheel and 7 in. Buff. Most makers charge $50 or more..... **$25.00**
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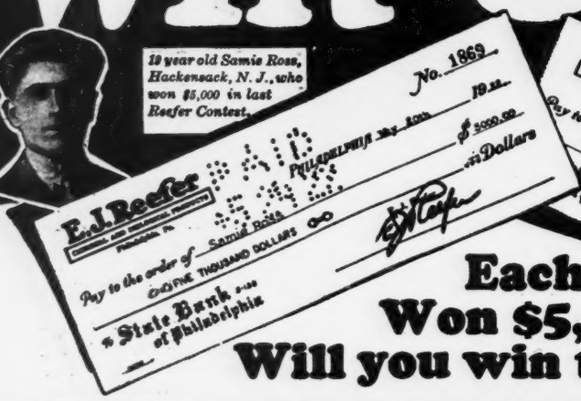
Win $5,000

18 year old Samie Ross, Hackensack, N. J., who won $5,000 in last Reefer Contest.



Mrs. B. R. Young of Girard, Pa., is another winner of a $5,000 contest prize.

Each Won $5,000 Will you win this time?

Big Picture FREE On Request

Can You Find More Than 15 or 20 Words in This Picture Beginning with Letter "R"?

There is Road, Rake, Rope. How many more can you find? Write them down and send them in as soon as possible. See how easy it is! Everything is in plain sight. No need to turn the picture upside down. This is a game of skill. Effort will help you win.

Costs Nothing to Try!

Just send in your list of "R" words. If the judges decide your list is the largest which correctly names the visible objects beginning with "R", they will award you first prize. If your list is the second best list, they will award you second prize, etc. Get started RIGHT NOW!

Win the $5,000 Prize!

You do not have to buy any Vimogen Yeast Tablets to enter this contest and win a prize.

If the judges decide your list of "R" words is best and you have not ordered any, you will win first prize **$50**
(See column 1 of prize list)

If you send in an order for one $1 package, and your list is awarded first prize, you win **$750**
(See 2nd column of prize list)

If you order two $1 packages and your list wins first prize, you get **$1,500**
(See 3rd column of prize list)

And if you order five $1 packages, and you are awarded first prize, you get . . **$5,000**
(See 4th column of prize list)

$11,500 in Prizes	If no Reefer's Yeast Tablets are ordered	If one $1 pkg. Reefer's Yeast Tablets is ordered	If two $1 pkgs. Reefer's Yeast Tablets are ordered	If five $1 pkgs. Reefer's Yeast Tablets are ordered
1st prize	$50	$750	$1500	$5000
2nd prize	35	375	750	2500
3rd prize	25	200	400	1250
4th prize	25	125	250	600
5th prize	25	75	150	400
6th to 55th prizes, each	2	4	8	25
56th to 105th prizes, each	1	2	4	10

No goods bought in this contest are subject to exchange, refund or approval.

And besides there are 104 other big cash prizes. Second prize in column 4 is $2,500. Third prize $1,250, etc. Just think of it — 105 chances for you to win.

$600 Extra for Promptness

The last day for mailing your solution to win any of the above prizes is November 15, 1922. But for every day ahead of that date that your order for goods is received, a special extra prize of $10 for each day will be added to any first prize you win. You can send your order today. Then anytime before November 15th you can qualify this order by sending in your solution. $600 extra is to be awarded for promptness. Try to get this extra $600. In case of ties for any prize offered each tying contestant will receive full amount of the prize so tied for.

Win All You Can!

Be sure to send your order for $5 worth of Yeast Tablets if you wish to qualify your list of words for the $5,000 first prize and the other prizes in the 4th column of the prize list. Don't delay sending in your order. Get the extra prize for promptness. Send your order today.

OBSERVE THESE RULES

1—Any one excepting our employees and their relatives may enter this contest. There is no entrance fee of any kind.

2—All word lists must be received through the mail by E. J. Reefer, 9th & Spruce Sts., Philadelphia, Pa., and envelopes must be postmarked by post office closing time, November 15, 1922.

3—Contestants who have sent lists or orders before November 15th will be qualified for the higher prizes provided orders for Yeast are received through the mail, postmarked on or before November 20th.

4—Only English words will be counted. Obsolete, hyphenated or compound words will not be counted. Only the singular or the plural of a word will be used, but both singular and plural will not count. Each article or object can be given only one name. Single words made up of two separate words or objects, such as teaspoon, teapot, or teatime will not count. Webster's International Dictionary will be the final authority. Where several synonyms are equally applicable to an object shown in the picture, a person submitting any one of such synonyms will be given credit for one word only.

5—The largest list of words which correctly name visible objects beginning with the letter "R" will receive first prize, and so on down the list of 105 prizes. The winning list will be made up from among the words submitted by the contestants, and not controlled by any predetermined list of words selected by the judges as being the "correct" or "master" list.

6—For each wrong word a percentage will be deducted from the total number of correct words.

7—Two or more people may co-operate in answering the puzzle. However, only one prize will be given to any one household or any one group.

8—If a contestant sends us more than one list under an assumed name or premarried name, then all lists of such contestant will be disqualified.

9—You must use only one side of paper. You must number each page and object in a consecutive rotation. Your full name and address must be written on each page in the upper right hand corner. It will aid the judges materially if you will arrange your words alphabetically, and if you will use paper size about 6 in. by 9 in. Failure to do so, however, will not count against you, nor will neatness or handwriting affect your score. Typewrite your list, if possible. An enlarged picture will be furnished free upon request.

10—The final decision will be made by three judges entirely independent of and having no connection whatever with the E. J. Reefer Company. They will judge the answers submitted and award the prizes at the end of the contest. Each participant entering this contest agrees to accept the decision of the judges as final and conclusive, without argument or question. All answers will receive full consideration, whether or not merchandise is purchased. At the close of the contest, when all lists have been graded, the list winning first prize and the names of the prize winners will be published, and a copy of such list and prize winners' names and addresses will be sent upon request to any participant who sends us a self-addressed, stamped envelope.

11—An additional prize of not over $600 for promptness, as specified above, will be awarded.

12—In case of ties for any prize offered, each tying contestant will receive full amount of the prize so tied for.

Yeast Tablets!

The greatest of all yeast products. Something entirely new. A wonderful scientific tablet that embodies all three natural vitamines. Enables your body to derive proper nourishment from the food you eat. Helps build up vitality, strength, endurance. Most all people are undernourished, though many don't know it. Try this scientific way to bring back the springy step, the buoyant freshness of youth, or the youthful natural complexion that all women long for. Think how wonderful life would be without that continual "tired feeling", with plenty of energy to work hard and play hard. Take this opportunity — find out what Reefer's Vimogen will do for you.

Start Today — Now!

Send today for Reefer's Yeast Tablets and qualify also for the biggest prizes. $50 or $5,000 which do want?

FREE Everyone sending for a large size picture will receive, fully prepaid, a package of a world famous, exquisitely scented, high priced Complexion Powder. Send for your free package today sure.

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